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ROYAL AIRCRAFT ESTABLISHMENT

FARNBOROUGH, HANTS

REPORT No: STRUCTURES 201

AERODYNAMIC DERIVATIVES FOR TWO CROPPED DELTA WINGS AND ONE ARROWHEAD WING OSCILLATING IN DISTORTION MODES

by

D.L.WOODCOCK, M.A.

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Aerodynamic derivatives for two cropped delta wings and one arrowhead wing oscillating in distortion modes

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SUMMARY

Aerodynamic derivatives are given for three particular planforms oscillating with symmetric distortion modes in incompressible flow. The planforms are:

(i) a cropped delta wing of aspect ratio 3 and taper ratio $^1/_7$;

(ii) a cropped delta wing of aspect ratio 1.2 and taper ratio $^1/_7$;

(iii) an arrowhead wing of aspect ratio 1.32, taper ratio $^7/_{18}$ and angle of sweep of 63.4° at the quarter chord.

The results are for modes of the form $|\eta|^n$ for $n = 0(1)4$ where η is a non-dimensional spanwise co-ordinate. They have been determined from intermediate results which D. E. Lehrian had earlier obtained by the vortex lattice method. The results are compared, for some cases, with the corresponding values given by very low aspect ratio theory.

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C	=	$\dfrac{K_1\left(\frac{i\nu}{2}\right)}{\left\{K_0\left(\frac{i\nu}{2}\right)+K_1\left(\frac{i\nu}{2}\right)\right\}}$
c	=	wing chord
c_m	=	mean wing chord
$(\ell_z)_{ij}$ etc.		equivalent constant strip derivatives
(ℓ_z) etc.		matrices of equivalent constant strip derivatives
$[\ell_z]_{ij}$ etc.		overall derivatives
$[\ell_z]$ etc.		matrices of overall derivatives
S	=	wing area
s	=	wing semi-span
t	=	time
V	=	airspeed
W	=	matrix of downwash velocities at collocation points due to the assumed doublet distribution
x	=	distance aft of mid chord axis
y	=	distance spanwise from wing centre line
$z\, e^{i\omega t}$	=	downward displacement of any point
$\Gamma\, e^{i\omega t}$	=	bound vorticity
Γ_n	=	bound vorticity distribution functions
η	=	$\dfrac{y}{s}$
θ	=	$\cos^{-1}\left(-\dfrac{2x}{c}\right)$
ν	=	$\dfrac{\omega c}{V}$
ν_m	=	$\dfrac{\omega c_m}{V}$
ρ	=	air density
ω	=	circular frequency

1 Introduction

In 1951 D. E. Lehrian[1] published values of the aerodynamic derivatives for a cropped delta wing of aspect ratio 3, taper ratio $^1/7$ oscillating with rigid modes in incompressible flow. From some of her intermediate results the derivatives for the same wing oscillating in distortion modes of the form $|\eta|^n$ were obtained and published in reference 2.

In reference 1 the first of the chordwise distribution functions for the bound vorticity was taken to be

$$\Gamma_o = 2 \left[C(\nu) \cot \tfrac{1}{2}\theta + \tfrac{1}{2}i\nu \sin \theta\right] \qquad (1)$$

that is, the function which arises in two-dimensional theory. The use of this function was found to give erroneous values of the damping derivatives for small values of ν because of the presence of a term $\nu \log \nu$ in the limiting value of $C(\nu)$ as ν tends to zero. To avoid this error D. E. Lehrian used instead the function

$$\Gamma_o = 2 \cot \tfrac{1}{2}\theta \qquad (2)$$

in reference 3. In that report she obtained rigid mode derivatives for two cropped delta wings both of taper ratio $^1/7$ and of aspect ratios 1.2 and 3, and also for an arrowhead wing of aspect ratio 1.32, taper ratio $^7/18$ and angle of sweep of 63.4° at the quarter chord. The present report gives the derivatives for these three wings oscillating in distortion modes of the form $|\eta|^n$. These have been obtained from the values, given in reference 3, of the matrices of the downwash velocities at the collocation points induced by the assumed doublet distribution functions.

2 Method

The method of determining the derivatives is described in reference 2. It will therefore be sufficient for our present purpose to give only those details which are necessary for the correct understanding of the results.

To obtain the derivatives for modes of the form $|\eta|^n$ for $n = 0(1)4$ the downward displacement of any point on the wing, with the exponential factor omitted is assumed to be given by

$$z = \sum_{i=o}^{4} c_m |\eta|^i \psi_i - \tfrac{1}{2} c \cos \theta \sum_{r=o}^{4} |\eta|^r \chi_r . \qquad (3)$$

This is not quite the same form as that used in reference 2. The reference length used in defining the flexural displacement has been changed from the semi-span s to the mean chord c_m. This modification simplifies some of the expressions which appear later. It should also be noted that the displacement in any particular degree of freedom is either purely flexural or purely torsional. The air forces for degrees of freedom containing both flexure and torsion are considered later.

If Ψ_i, X_r are the generalised forces corresponding to the degrees of freedom ψ_i, χ_r then

$$\left.\begin{aligned} \Psi_i &= \sum_{j=0}^{4} \Psi_{ij}^{\psi}\, \psi_j + \sum_{s=0}^{4} \Psi_{is}^{\chi}\, \chi_s \\ X_r &= \sum_{j=0}^{4} X_{rj}^{\psi}\, \psi_j + \sum_{s=0}^{4} X_{rs}^{\chi}\, \chi_s \end{aligned}\right\} \tag{4}$$

where the matrices $\Psi^{\psi} \left(\equiv [\Psi_{ij}^{\psi}]\right)$ etc. are given by

$$\left.\begin{aligned} \Psi^{\psi} &= -\pi\rho V^2 S s R_z (\bar{W}^{-1})' S_z \\ \Psi^{\chi} &= -\pi\rho V^2 S s R_z (\bar{W}^{-1})' S_\alpha \\ X^{\psi} &= -\pi\rho V^2 S s R_\alpha (\bar{W}^{-1})' S_z \\ X^{\chi} &= -\pi\rho V^2 S s R_\alpha (\bar{W}^{-1})' S_\alpha . \end{aligned}\right\} \tag{5}$$

$\bar{W}$ is the matrix of the downwash velocities at the collocation points due to the assumed doublet distribution (see reference 2)*. The other matrices R_z, S_z etc. are given by the following relationships (appropriate to six collocation points situated at the intersection of the lines $\eta = \eta_1, \eta_2, \eta_3$ and $\theta = \theta_1, \theta_2$):-

$$R_z = \left[J, \frac{i\nu_m}{8} K\right] \tag{6}$$

$$S_z = i\nu_m \{N, N\} \tag{7}$$

$$R_\alpha = -\tfrac{1}{4}\left[K, \tfrac{1}{2}K + \frac{i\nu_m}{16} G\right] \tag{8}$$

and

$$S_\alpha = \begin{bmatrix} N - \tfrac{1}{2}i\nu_m \cos\theta_1 \cdot HN \\ N - \tfrac{1}{2}i\nu_m \cos\theta_2 \cdot HN \end{bmatrix} \tag{9}$$

---

* The matrix used in reference 3 is the transpose of the one used in reference 2 and in this report.

where

$$N = \begin{array}{c} 1 \\ 1 \\ 1 \end{array} \begin{bmatrix} \eta_1 & \eta_1^2 & \eta_1^3 & \eta_1^4 \\ \eta_2 & \eta_2^2 & \eta_2^3 & \eta_2^4 \\ \eta_3 & \eta_3^2 & \eta_3^3 & \eta_3^4 \end{bmatrix} \tag{10}$$

$$J^{**} = \begin{bmatrix} J_{00} & J_{02} & J_{04} \\ J_{10} & J_{12} & J_{14} \\ J_{20} & J_{22} & J_{24} \\ J_{30} & J_{32} & J_{34} \\ J_{40} & J_{42} & J_{44} \\ J_{50} & J_{52} & J_{54} \\ J_{60} & J_{62} & J_{64} \end{bmatrix} \tag{11}$$

$$J_{rs} = \int_0^1 \eta^{r+s} \sqrt{1 - \eta^2}\, d\eta \tag{12}$$

$$J^* = \text{first six rows of } J^{**} \tag{13}$$

$$J = \text{first five rows of } J^{**} \tag{14}$$

$$\frac{c}{c_m} = a - b\eta \tag{15}$$

$$L^* = \begin{bmatrix} a & -b & 0 & 0 & 0 & 0 & 0 \\ 0 & a & -b & 0 & 0 & 0 & 0 \\ 0 & 0 & a & -b & 0 & 0 & 0 \\ 0 & 0 & 0 & a & -b & 0 & 0 \\ 0 & 0 & 0 & 0 & a & -b & 0 \\ 0 & 0 & 0 & 0 & 0 & a & -b \end{bmatrix} \tag{16}$$

$$L = \text{first five rows and six columns of } L^* \tag{17}$$

$$K = L\, J^* \tag{18}$$

$$K^* = L^*\, J^{**} \tag{19}$$

$$G = LK^* = LL^*\, J^{**} \tag{20}$$

and

$$H = \operatorname{diag}\left\{\frac{c}{c_m}(\eta_1),\ \frac{c}{c_m}(\eta_2),\ \frac{c}{c_m}(\eta_3)\right\}. \tag{21}$$

The matrices Ψ^{ψ} etc., when made non-dimensional are divided up into matrices of the overall derivatives. Thus

$$\left.\begin{aligned}
\Psi^{\psi} &= -\rho V^2 S c_m \{[\ell_z] + i\nu_m [\ell_{\dot{z}}]\} \\
\Psi^{\chi} &= -\rho V^2 S c_m \{[\ell_\alpha] + i\nu_m [\ell_{\dot{\alpha}}]\} \\
X^{\psi} &= -\rho V^2 S c_m \{[-m_z] + i\nu_m [-m_{\dot{z}}]\} \\
X^{\chi} &= -\rho V^2 S c_m \{[-m_\alpha] + i\nu_m [-m_{\dot{\alpha}}]\}
\end{aligned}\right\} \tag{22}$$

where

$$[\ell_z] = \Big[[\ell_z]_{ij}\Big] \text{ etc.} \tag{23}$$

and so

$$\left.\begin{aligned}
[\ell_z] &= \pi \frac{s}{c_m} R\ell \left\{R_z\, (\bar{W}^{-1})^t\, S_z\right\} \\
[\ell_\alpha] &= \pi \frac{s}{c_m} R\ell \left\{R_z\, (\bar{W}^{-1})^t\, S_\alpha\right\} \\
[-m_z] &= \pi \frac{s}{c_m} R\ell \left\{R_\alpha\, (\bar{W}^{-1})^t\, S_z\right\} \\
[-m_\alpha] &= \pi \frac{s}{c_m} R\ell \left\{R_\alpha\, (\bar{W}^{-1})^t\, S_\alpha\right\}
\end{aligned}\right\} \tag{24}$$

and

$$\left.\begin{aligned}
[\ell_{\dot z}] &= \pi \frac{s}{c_m \nu_m} \,\mathscr{I}m \left\{ R_z \, (\bar{W}^{-1})' \, S_z \right\} \\
[\ell_{\dot \alpha}] &= \pi \frac{s}{c_m \nu_m} \,\mathscr{I}m \left\{ R_z \, (\bar{W}^{-1})' \, S_\alpha \right\} \\
[-m_{\dot z}] &= \pi \frac{s}{c_m \nu_m} \,\mathscr{I}m \left\{ R_\alpha \, (\bar{W}^{-1})' \, S_z \right\} \\
[-m_{\dot \alpha}] &= \pi \frac{s}{c_m \nu_m} \,\mathscr{I}m \left\{ R_\alpha \, (\bar{W}^{-1})' \, S_\alpha \right\} .
\end{aligned}\right\} \qquad (25)$$

The stiffness derivatives thus include the virtual inertia contribution.

The equivalent constant strip derivatives $(\ell_z)_{ij}$ etc. are related to the overall derivatives by the formulae:-

$$\left.\begin{aligned}
[\ell_z]_{ij} &= (\ell_z)_{ij} \int_0^1 \eta^{i+j} \, d\eta \\
[\ell_\alpha]_{is} &= (\ell_\alpha)_{is} \int_0^1 \frac{c}{c_m} \eta^{i+s} \, d\eta \\
[-m_z]_{rj} &= (-m_z)_{rj} \int_0^1 \frac{c}{c_m} \eta^{r+j} \, d\eta \\
[-m_\alpha]_{rs} &= (-m_\alpha)_{rs} \int_0^1 \left(\frac{c}{c_m}\right)^2 \eta^{r+s} \, d\eta
\end{aligned}\right\} \qquad (26)$$

/(27)

$$
\left.
\begin{aligned}
[\ell_{\dot z}]_{ij} &= (\ell_{\dot z})_{ij} \int_0^1 \frac{c}{c_m}\, \eta^{i+j}\, d\eta \\
[\ell_{\dot\alpha}]_{is} &= (\ell_{\dot\alpha})_{is} \int_0^1 \left(\frac{c}{c_m}\right)^2 \eta^{i+s}\, d\eta \\
[-m_{\dot z}]_{rj} &= (-m_{\dot z})_{rj} \int_0^1 \left(\frac{c}{c_m}\right)^2 \eta^{r+j}\, d\eta \\
[-m_{\dot\alpha}]_{rs} &= (-m_{\alpha})_{rs} \int_0^1 \left(\frac{c}{c_m}\right)^3 \eta^{r+s}\, d\eta\, .
\end{aligned}
\right\} \tag{27}
$$

These equivalent constant strip derivatives are the same as the equivalent constant derivatives of reference 2.

The generalised forces for a set of degrees of freedom whose modes of displacement can be expressed as linear combinations of the above modes (equation (3)) can be obtained from the overall derivatives for the above modes. Thus if the displacement in the u^{th} degree of freedom is

$$
z = \left\{ c_m\, f_u(\eta) - \tfrac{1}{2} c \cos\theta . F_u(\eta) \right\} q_u \tag{28}
$$

where

$$
\left.
\begin{aligned}
f_u(\eta) &= \sum_{i=0}^{4} g_{ui}\, |\eta|^i \\
F_u(\eta) &= \sum_{r=0}^{4} G_{ur}\, |\eta|^r
\end{aligned}
\right\}^{*} \tag{29}
$$

then the corresponding generalised force is Q_u where

$$
Q_u = \sum_r Q_{ur}\, q_r \tag{30}
$$

---

* f_u, F_u are coupled flexural and torsional modal functions, i.e. they describe the displacement in the same degree of freedom.

$$Q = [Q_{uv}] = [g, G] \begin{bmatrix} \Psi_\psi & \Psi_\chi \\ X_\psi & X_\chi \end{bmatrix} \begin{bmatrix} g' \\ G' \end{bmatrix}$$

$$= -\rho V^2 S c_m [g, G] \left\{ \begin{bmatrix} [\ell_z][\ell_\alpha] \\ [-m_z][-m_\alpha] \end{bmatrix} + i\nu_m \begin{bmatrix} [\ell_{\dot z}][\ell_{\dot\alpha}] \\ [-m_{\dot z}][-m_{\dot\alpha}] \end{bmatrix} \right\} \begin{bmatrix} g' \\ G' \end{bmatrix} \quad (31)$$

$$g = [g_{ui}] \quad (32)$$

and

$$G = [G_{uj}] . \quad (33)$$

Alternatively the generalised forces for degrees of freedom whose modes of displacement are distinct from those of equation (3) can be obtained directly from the reciprocal matrix $(\bar{W}^{-1})'$. If the displacement in the u^{th} degree of freedom is given by equation (28) though with f_u, F_u not necessarily given by equation (29) then the matrix Q of the generalised force coefficients Q_{uv} is given by

$$Q = -\pi \rho V^2 S s (\hat{R}_z + \hat{R}_\alpha) (\bar{W}^{-1})' (\hat{S}_z + \hat{S}_\alpha) \quad (34)$$

where

$$\hat{R}_z = \left[\hat{J}, \frac{i\nu_m}{8} \hat{k}\right] \quad (35)$$

$$\hat{S}_z = i\nu_m \{\hat{n}, \hat{n}\} \quad (36)$$

$$\hat{R}_\alpha = -\tfrac{1}{4} \left[\hat{K}, \tfrac{1}{2}\hat{K} + \frac{i\nu_m}{16} \hat{G}\right] \quad (37)$$

$$\hat{S}_\alpha = \begin{bmatrix} \hat{N} - \tfrac{1}{2} i\nu_m \cos\theta_1 \cdot H\hat{N} \\ \hat{N} - \tfrac{1}{2} i\nu_m \cos\theta_2 \cdot H\hat{N} \end{bmatrix} \quad (38)$$

and, for (1 + a) degrees of freedom, where

$$\hat{J} = \begin{bmatrix} \hat{J}_{00} & \hat{J}_{02} & \hat{J}_{04} \\ \hat{J}_{10} & \hat{J}_{12} & \hat{J}_{14} \\ \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots \\ \hat{J}_{a0} & \hat{J}_{a2} & \hat{J}_{a4} \end{bmatrix} \quad (39)$$

$$\hat{j}_{rs} = \int_o^1 f_r(\eta)\, \eta^s \sqrt{1 - \eta^2}\, d\eta \tag{40}$$

$$\hat{k} = \begin{bmatrix} \hat{k}_{00} & \hat{k}_{02} & \hat{k}_{04} \\ \hat{k}_{10} & \hat{k}_{12} & \hat{k}_{14} \\ \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots \\ \hat{k}_{a0} & \hat{k}_{a2} & \hat{k}_{a4} \end{bmatrix} \tag{41}$$

$$\hat{k}_{rs} = \int_o^1 \frac{c}{c_m} f_r(\eta)\, \eta^s \sqrt{1 - \eta^2}\, d\eta \tag{42}$$

$$\hat{n} = \begin{bmatrix} f_o(\eta_1) & f_1(\eta_1) \;\cdots & f_a(\eta_1) \\ f_o(\eta_2) & \cdots & \\ f_o(\eta_3) & \cdots & \end{bmatrix} \tag{43}$$

$$\hat{K} = \begin{bmatrix} \hat{K}_{00} & \hat{K}_{02} & \hat{K}_{04} \\ \hat{K}_{10} & \hat{K}_{12} & \hat{K}_{14} \\ \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots \\ \hat{K}_{a0} & \hat{K}_{a2} & \hat{K}_{a4} \end{bmatrix} \tag{44}$$

$$\hat{K}_{rs} = \int_o^1 \frac{c}{c_m} F_r(\eta)\, \eta^s \sqrt{1 - \eta^2}\, d\eta \tag{45}$$

$$\hat{G} = \begin{bmatrix} \hat{G}_{00} & \hat{G}_{02} & \hat{G}_{04} \\ \hat{G}_{10} & \hat{G}_{12} & \hat{G}_{14} \\ \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots \\ G_{a0} & \hat{G}_{a2} & G_{a4} \end{bmatrix} \tag{46}$$

$$\hat{G}_{rs} = \int_0^1 \left(\frac{c}{c_m}\right)^2 F_r(\eta)\, \eta^s \sqrt{1-\eta^2}\, d\eta \tag{47}$$

and

$$\hat{N} = \begin{bmatrix} F_o(\eta_1) & F_1(\eta_1) \;\cdots\cdots\; F_a(\eta_1) \\ F_o(\eta_2) & \cdots\cdots & \\ F_o(\eta_3) & \cdots\cdots & \end{bmatrix} . \tag{48}$$

3 Results

Derivatives for the particular set of modes of equation (3) have been obtained from D. E. Lehrian's[3] values of the matrix of the downwash velocities induced by the assumed doublet distribution functions for the following cases:-

(i) cropped delta wing, aspect ratio = 3, taper ratio = 1/7

$$\nu_m = 0.2\dot{6},\ 0.4\ *$$

(ii) cropped delta wing, aspect ratio = 1.2, taper ratio = 1/7

$$\nu_m = 0.\dot{3},\ 0.\dot{6}$$

(iii) arrowhead wing, aspect ratio = 1.32, taper ratio = 7/18, quarter chord sweep = 63.4°

$$\nu_m = 0.303,\ 0.606\ .$$

The results are presented (Tables 4 to 51) as matrices $[\ell_z]$ etc. of the overall derivatives and also as matrices (ℓ_z) etc. of the equivalent constant strip derivatives (see equations (22) to (27)).

The overall derivatives for the delta wings have also been compared with the corresponding values given by very low aspect ratio theory. The ratios of the values from the two theories are given in Tables 52 to 56. The derivatives $[\ell_z]_{rs}$, $[-m_z]_{rs}$ were not compared because their very low aspect ratio theory form consists only of the virtual inertia contribution, which is proportional to ν_m^2. The other two stiffness derivatives, as given by very low aspect ratio theory, only differ from two damping derivatives $\left([\ell_\alpha]_{rs}\ \text{from}\ [\ell_{\dot{z}}]_{rs}\ \text{and}\ [-m_\alpha]_{rs}\ \text{from}\ [-m_{\dot{z}}]_{rs}\right)$ in the virtual inertia contribution. It has therefore been considered sufficient to perform the comparison for only one of the stiffness derivatives, i.e. $[-m_\alpha]_{rs}$ in addition to the comparison for the damping derivatives.

---

* $\ell_{\dot{z}}$ has also been obtained for $\nu_m = 0.5\dot{3}$.

The matrices $(\bar{W}^{-1})'$ from which the generalised force for any mode* can be obtained by using equation (34) are given in Tables 1 to 3 for each of the three planforms. The generalised force for any such mode can alternatively be obtained, as is shown earlier, from the derivative for the modes $|\eta|^n$ by expressing this new mode as a linear combination of such modes.

4 Conclusions

Comparison of the present results, for the wing of aspect ratio 3 at $\nu_m = 0.26$, with those of reference 2 shows very close agreement except for ℓ_z and $\ell_{\dot\alpha}$. ℓ_z is small in any case and of no importance. The two derivatives $\ell_{\dot\alpha}$, $m_{\dot\alpha}$ tend to infinity as the frequency approaches zero when the method of reference 1 (and hence of reference 2) is used. Thus some difference in the values of these two derivatives is more to be expected than for the others. The difference in the $\ell_{\dot\alpha}$ is in no case greater than about 10%. It is suggested that, for this wing, the derivatives for any intermediate value of the frequency parameter should be obtained by interpolation between the values given in this report for $\nu_m = 0.26$, 0.4 and those given in reference 2 for $\nu_m = 0.8$.

The comparison of the values of the derivatives for the cropped delta wings with those given by very low aspect ratio theory does not indicate any simple rule for finding the effect of aspect ratio variation. However, the Tables 52 to 56 should be of use when interpolating for the derivatives for wings of other aspect ratios.

REFERENCES

No.	Author	Title, etc.
1	D.E. Lehrian	Aerodynamic coefficients for an oscillating delta wing. R & M 2841. July, 1951.
2	D.L. Woodcock	Aerodynamic derivatives for a delta wing oscillating in elastic modes. C.P. No. 170. July 1952.
3	D.E. Lehrian	Calculation of flutter derivatives for wings of general planform. ARC No. 16,445 O.1094. January 1954.

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* A finer lattice and a greater number of collocation points would however be necessary to ensure accuracy for modes containing more than two nodes in flexure or two nodes in torsion.

Attached:- Tables 1 - 56
Detachable Abstract Cards

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TABLE 1

Cropped delta wing, aspect ratio 3, taper ratio $^1/_7$

Values of $(\bar{W}^{-1})'$. Collocation points $\eta = 0.2, 0.6, 0.8$; $\theta = \pi/2, \cos^{-1}(-2/3)$

(i) $\nu_B = 0.2\dot{6}$

$$(\bar{W}^{-1})' = \begin{bmatrix} 0.0225392 + 0.00200296\,i & 0.0290779 + 0.00414864\,i & 0.00603909 - 0.00027649\,i & 0.316227 + 0.0430338\,i & 0.0122139 - 0.00297499\,i & 0.0185885 - 0.00129445\,i \\ 0.0556895 - 0.00103171\,i & -0.0810637 - 0.0221190\,i & 0.0610248 + 0.00740540\,i & -0.822098 - 0.226353\,i & 0.989791 + 0.106049\,i & -0.233730 - 0.01481525\,i \\ -0.0596166 - 0.00576412\,i & 0.0562707 + 0.0205397\,i & -0.0226268 - 0.00955259\,i & 0.704850 + 0.214333\,i & -1.433203 - 0.185892\,i & 0.764327 + 0.0536731\,i \\ 1.363852 - 0.00701844\,i & -0.0896994 - 0.0122025\,i & 0.0216108 - 0.00035209\,i & -1.275028 - 0.128977\,i & -0.0338126 + 0.00618210\,i & -0.0426602 - 0.00169168\,i \\ -5.267813 - 0.00890004\,i & 5.468738 + 0.0501269\,i & -1.338292 - 0.0230398\,i & 4.904290 + 0.507518\,i & -4.422744 - 0.318949\,i & 0.917631 + 0.0445423\,i \\ 5.030480 + 0.0184339\,i & -8.259517 - 0.0492145\,i & 3.943225 + 0.0250388\,i & -4.713078 - 0.515066\,i & 7.154355 + 0.500297\,i & -3.265256 - 0.150782\,i \end{bmatrix}$$

(ii) $\nu_B = 0.4$

$$(\bar{W}^{-1})' = \begin{bmatrix} 0.0214493 + 0.00337816\,i & 0.0279290 + 0.00641046\,i & 0.00563982 - 0.00017732\,i & 0.303503 + 0.0669137\,i & 0.0105118 - 0.00322826\,i & 0.0176538 - 0.00134805\,i \\ 0.0557764 - 0.00111789\,i & -0.0783887 - 0.0326391\,i & 0.0600125 + 0.0112369\,i & -0.795140 - 0.333619\,i & 0.978188 + 0.159247\,i & -0.233443 - 0.0217409\,i \\ -0.0593383 - 0.00888738\,i & 0.0535019 + 0.0303350\,i & -0.0214645 - 0.0143413\,i & 0.6765805 + 0.316415\,i & -1.415863 - 0.277994\,i & 0.761297 + 0.0800823\,i \\ 1.364393 - 0.0108526\,i & -0.0888871 - 0.0185138\,i & 0.0217143 - 0.00070529\,i & -1.266267 - 0.195948\,i & -0.0341315 + 0.00824058\,i & -0.0421154 - 0.00288292\,i \\ -5.268731 - 0.00891207\,i & 5.465260 + 0.0760036\,i & -1.337698 - 0.0337169\,i & 4.868004 + 0.771146\,i & -4.411369 - 0.470525\,i & 0.915216 + 0.0685337\,i \\ 5.030526 + 0.0263355\,i & -8.256059 - 0.0744391\,i & 3.941939 + 0.0367235\,i & -4.677501 - 0.780397\,i & 7.133722 + 0.745549\,i & -3.261108 - 0.227897\,i \end{bmatrix}$$

(iii) $\nu_B = 0.5\dot{3}$

$$(\bar{W}^{-1})' = \begin{bmatrix} 0.0201498 + 0.00486362\,i & 0.0264547 + 0.00868509\,i & 0.00521455 + 0.000006859\,i & 0.287322 + 0.0910628\,i & 0.00880919 - 0.00292009\,i & 0.0166785 - 0.00123406\,i \\ 0.0560939 - 0.00090229\,i & -0.0745570 - 0.0426276\,i & 0.0587255 + 0.0150878\,i & -0.756270 - 0.435238\,i & 0.962621 + 0.212026\,i & -0.232709 - 0.0284721\,i \\ -0.0590522 - 0.0121470\,i & 0.0496198 + 0.0396491\,i & -0.0199258 - 0.0190396\,i & 0.636794 + 0.413534\,i & -1.392067 - 0.368843\,i & 0.756823 + 0.1063756\,i \\ 1.365065 - 0.0146607\,i & -0.0877573 - 0.0247337\,i & 0.0217913 - 0.00107614\,i & -1.254186 - 0.261980\,i & -0.0350064 + 0.0100720\,i & -0.0414913 - 0.00408943\,i \\ -5.269744 - 0.0110183\,i & 5.460572 + 0.1015938\,i & -1.336737 - 0.0443544\,i & 4.819244 + 1.031787\,i & -4.394263 - 0.623371\,i & 0.911800 + 0.0924022\,i \\ 5.030036 + 0.0345561\,i & -8.251332 - 0.0992454\,i & 3.940146 + 0.0485010\,i & -4.628844 - 1.041169\,i & 7.104543 + 0.990879\,i & -3.255041 - 0.304633\,i \end{bmatrix}$$

TABLE 2

Cropped delta wing, aspect ratio 1.2, taper ratio $^1/_7$

Values of $(\bar{W}^{-1})'$. Collocation points $\eta = 0.2,\ 0.6,\ 0.8;\ \theta = \pi/2,\ \cos^{-1}(-2/3)$

(i) $\nu_m = 0.\dot{3}$

$$(\bar{W}^{-1})' = \begin{bmatrix} -0.0237578 - 0.00633154\,i & 0.0216512 + 0.00564909\,i & 0.0231512 + 0.00563599\,i & 0.424736 + 0.105432\,i & 0.0574129 + 0.0143236\,i & 0.0216975 + 0.0015268\,i \\ 0.175257 + 0.0460266\,i & -0.258558 - 0.0564680\,i & 0.113704 + 0.00608060\,i & -0.906357 - 0.387094\,i & 1.169472 + 0.153145\,i & -0.236250 - 0.0101657\,i \\ -0.146217 - 0.0508979\,i & 0.268967 + 0.0731221\,i & -0.166775 - 0.0245091\,i & 0.757519 + 0.342308\,i & -1.695324 - 0.299513\,i & 0.909271 + 0.0839304\,i \\ 2.202742 + 0.0176058\,i & 0.162477 - 0.0169556\,i & -0.0101628 - 0.0125134\,i & -2.124794 - 0.270202\,i & -0.380305 - 0.0211572\,i & -0.138046 - 0.00724790\,i \\ -7.596654 - 0.122262\,i & 7.091582 + 0.152887\,i & -1.240887 - 0.0243090\,i & 7.112414 + 0.965050\,i & -5.327479 - 0.452844\,i & 0.555150 + 0.0299858\,i \\ 7.148552 + 0.143942\,i & -11.780648 - 0.207086\,i & 5.461866 + 0.0671786\,i & -6.500334 - 0.994395\,i & 9.976231 + 0.838954\,i & -1.000238 - 0.242145\,i \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$(\bar{W}^{-1})' = \begin{bmatrix} -0.0206850 - 0.0119868\,i & 0.0188366 + 0.0105696\,i & 0.0203329 + 0.0111276\,i & 0.371728 + 0.203579\,i & 0.0506648 + 0.0294577\,i & 0.0195173 + 0.00325278\,i \\ 0.159323 + 0.0091033\,i & -0.240323 - 0.109755\,i & 0.114650 + 0.0132201\,i & -0.751469 - 0.737274\,i & 1.135253 + 0.304156\,i & -0.237348 - 0.0191279\,i \\ -0.127313 - 0.0982259\,i & 0.265023 + 0.142467\,i & -0.163464 - 0.0491214\,i & 0.599416 + 0.653059\,i & -1.624780 - 0.590945\,i & 0.898129 + 0.166304\,i \\ 2.197766 + 0.0347180\,i & 0.167082 - 0.033200\,i & -0.00823626 - 0.0256356\,i & -2.060404 - 0.541486\,i & -0.383892 - 0.0464523\,i & -0.132800 - 0.0151407\,i \\ -7.576256 - 0.243853\,i & 7.066621 + 0.304499\,i & -1.239385 - 0.046530\,i & 6.927449 + 1.942945\,i & -5.263991 - 0.893853\,i & 0.545952 + 0.0627700\,i \\ 7.125644 + 0.287511\,i & -11.72920 - 0.413313\,i & 5.452463 + 0.133172\,i & -6.344356 - 1.994478\,i & 9.856868 + 1.670265\,i & -3.977220 - 0.483819\,i \end{bmatrix}$$

TABLE 3

Arrowhead wing, aspect ratio 1.32, taper ratio $^7/_{18}$, quarter chord sweep 63.4°

Values of $(\bar{W}^{-1})'$. Collocation points $\eta = 0.2, 0.6, 0.8$; $\theta = \pi/2, \cos^{-1}(-2/3)$

(i) $\nu_m = 0.303$

$$(\bar{W}^{-1})' = \begin{bmatrix} -0.00597635 - 0.00105285\,i & 0.0647968 + 0.0114366\,i & 0.0196759 + 0.00346636\,i & 0.387154 + 0.0669696\,i & 0.00001259 + 0.00111327\,i & 0.00565135 - 0.00163208\,i \\ 0.0758004 + 0.0150561\,i & -0.370173 - 0.0886847\,i & 0.306929 + 0.0425353\,i & -0.775009 - 0.279312\,i & 1.319743 + 0.208015\,i & -0.402102 - 0.0443036\,i \\ -0.0763447 - 0.0184303\,i & 0.321429 + 0.0929088\,i & -0.365825 - 0.0705035\,i & 0.673457 + 0.245031\,i & -1.746032 - 0.334416\,i & 1.106342 + 0.150443\,i \\ 1.631941 + 0.00285903\,i & -0.0516418 - 0.0295115\,i & -0.0495464 - 0.00754546\,i & -1.592778 - 0.169610\,i & -0.188810 + 0.00287518\,i & -0.00990675 - 0.00015435\,i \\ -6.254524 - 0.0378466\,i & 7.263700 + 0.218052\,i & -1.877889 - 0.112978\,i & 6.163523 + 0.654616\,i & -5.325111 - 0.535030\,i & 0.990078 + 0.107708\,i \\ 6.469489 + 0.0507090\,i & -11.67341 - 0.264063\,i & 6.677138 + 0.183811\,i & -6.229230 - 0.730179\,i & 9.561615 + 0.886482\,i & -4.837179 - 0.385426\,i \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$(\bar{W}^{-1})' = \begin{bmatrix} -0.00511643 - 0.00227317\,i & 0.0593930 + 0.0226714\,i & 0.0179728 + 0.00709472\,i & 0.356302 + 0.132832\,i & -0.00071755 + 0.00300726\,i & 0.00546230 - 0.00308711\,i \\ 0.0400942 + 0.0222148\,i & -0.309186 - 0.162542\,i & 0.286341 + 0.0814971\,i & -0.667654 - 0.524097\,i & 1.239328 + 0.399514\,i & -0.389372 - 0.0851211\,i \\ 0.0151773 - 0.0114117\,i & 0.192866 + 0.147824\,i & -0.322894 - 0.128695\,i & 0.504576 + 0.433693\,i & -1.589814 - 0.623117\,i & 1.062574 + 0.290882\,i \\ 1.830524 + 0.00562200\,i & -0.0449570 - 0.0587690\,i & -0.0494247 - 0.0157182\,i & -1.562660 - 0.340317\,i & -0.193469 + 0.00369877\,i & -0.00908582 - 0.00004086\,i \\ -6.171489 - 0.0571077\,i & 7.142380 + 0.409283\,i & -1.840375 - 0.216303\,i & 5.984494 + 1.275760\,i & -5.186276 - 1.036091\,i & 0.957777 + 0.213151\,i \\ 6.078788 + 0.0357613\,i & -11.198362 - 0.427799\,i & 6.537915 + 0.336006\,i & -5.775126 - 1.321041\,i & 9.124875 + 1.653894\,i & -4.731732 - 0.746506\,i \end{bmatrix}$$

TABLE 4

Cropped delta wing, aspect ratio 3, taper ratio 1/7

Values of (ℓ_z)

(i) $\nu_m = 0.2\dot{6}$

$$
(\ell_z) = \begin{bmatrix}
-0.01688 & -0.007684 & -0.003288 & -0.001816 & -0.001310 \\
-0.003725 & -0.003129 & -0.003272 & -0.003475 & -0.003546 \\
0.002134 & -0.001024 & -0.002560 & -0.003336 & -0.003675 \\
0.005004 & 0.000225 & -0.001932 & -0.003003 & -0.003504 \\
0.006474 & 0.001044 & -0.001435 & -0.002688 & -0.003294
\end{bmatrix}
$$

(ii) $\nu_m = 0.4$

$$
(\ell_z) = \begin{bmatrix}
-0.04775 & -0.02489 & -0.01351 & -0.009325 & -0.07509 \\
-0.01718 & -0.01217 & -0.01102 & -0.01075 & -0.01041 \\
-0.003217 & -0.006464 & -0.008537 & -0.009640 & -0.009997 \\
0.003864 & -0.003089 & -0.006656 & -0.008490 & -0.009253 \\
0.007686 & -0.0008700 & -0.005244 & -0.007526 & -0.008549
\end{bmatrix}
$$

TABLE 5

Cropped delta wing, aspect ratio 3, taper ratio $^1/_7$

Values of (ℓ_α)

(i) $\nu_m = 0.26$

$$(\ell_\alpha) = \begin{bmatrix} 1.501 & 1.628 & 1.639 & 1.647 & 1.613 \\ 1.676 & 1.448 & 1.378 & 1.344 & 1.291 \\ 1.764 & 1.403 & 1.292 & 1.232 & 1.167 \\ 1.806 & 1.379 & 1.244 & 1.169 & 1.095 \\ 1.822 & 1.358 & 1.210 & 1.126 & 1.044 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$(\ell_\alpha) = \begin{bmatrix} 1.473 & 1.590 & 1.611 & 1.619 & 1.586 \\ 1.639 & 1.424 & 1.359 & 1.326 & 1.275 \\ 1.722 & 1.381 & 1.276 & 1.219 & 1.154 \\ 1.761 & 1.358 & 1.230 & 1.158 & 1.084 \\ 1.775 & 1.338 & 1.197 & 1.115 & 1.036 \end{bmatrix}$$

TABLE 6

Cropped delta wing, aspect ratio 3, taper ratio 1/7

Values of $(-m_z)$

(i) $\nu_m = 0.2\dot{6}$

$$(-m_z) = \begin{bmatrix} -0.008716 & -0.008535 & -0.007933 & -0.007628 & -0.007293 \\ -0.008272 & -0.005692 & -0.004604 & -0.004093 & -0.003718 \\ -0.007832 & -0.004617 & -0.003451 & -0.002926 & -0.002573 \\ -0.007420 & -0.003994 & -0.002837 & -0.002331 & -0.002008 \\ -0.007045 & -0.003565 & -0.002445 & -0.001966 & -0.001670 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$(-m_z) = \begin{bmatrix} -0.01760 & -0.01706 & -0.01574 & -0.01508 & -0.01440 \\ -0.01642 & -0.01126 & -0.009097 & -0.008092 & -0.007357 \\ -0.01543 & -0.009102 & -0.006819 & -0.005799 & -0.005115 \\ -0.01459 & -0.007867 & -0.005614 & -0.004635 & -0.004011 \\ -0.01385 & -0.007025 & -0.004843 & -0.003921 & -0.003350 \end{bmatrix}$$

TABLE 7

Cropped delta wing, aspect ratio 3, taper ratio $^1/_7$

Values of $(-m_\alpha)$

(i) $\nu_m = 0.2\dot{6}$

$$(-m_\alpha) = \begin{bmatrix} -0.3460 & -0.3862 & -0.3769 & -0.3756 & -0.3708 \\ -0.4029 & -0.3589 & -0.3430 & -0.3366 & -0.3258 \\ -0.4415 & -0.3628 & -0.3370 & -0.3240 & -0.3092 \\ -0.4673 & -0.3684 & -0.3351 & -0.3172 & -0.2994 \\ -0.4841 & -0.3721 & -0.3338 & -0.3123 & -0.2922 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$(-m_\alpha) = \begin{bmatrix} -0.3435 & -0.3807 & -0.3687 & -0.3656 & -0.3598 \\ -0.3977 & -0.3538 & -0.3378 & -0.3313 & -0.3203 \\ -0.4344 & -0.3576 & -0.3325 & -0.3198 & -0.3054 \\ -0.4590 & -0.3631 & -0.3311 & -0.3137 & -0.2963 \\ -0.4749 & -0.3668 & -0.3300 & -0.3092 & -0.2896 \end{bmatrix}$$

TABLE 8

Cropped delta wing, aspect ratio 3, taper ratio $^1/7$

Values of $(\ell_{\dot{z}})$

(i) $\nu_m = 0.2\dot{6}$

$$(\ell_{\dot{z}}) = \begin{bmatrix} 1.490 & 1.619 & 1.631 & 1.640 & 1.608 \\ 1.665 & 1.440 & 1.373 & 1.340 & 1.288 \\ 1.752 & 1.397 & 1.288 & 1.229 & 1.164 \\ 1.794 & 1.373 & 1.240 & 1.167 & 1.093 \\ 1.810 & 1.352 & 1.206 & 1.123 & 1.043 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$(\ell_{\dot{z}}) = \begin{bmatrix} 1.452 & 1.581 & 1.596 & 1.606 & 1.575 \\ 1.618 & 1.410 & 1.349 & 1.318 & 1.268 \\ 1.701 & 1.368 & 1.267 & 1.212 & 1.150 \\ 1.739 & 1.345 & 1.222 & 1.152 & 1.080 \\ 1.754 & 1.325 & 1.189 & 1.110 & 1.032 \end{bmatrix}$$

(iii) $\nu_m = 0.5\dot{3}$

$$(\ell_{\dot{z}}) = \begin{bmatrix} 1.413 & 1.543 & 1.560 & 1.571 & 1.542 \\ 1.569 & 1.378 & 1.324 & 1.297 & 1.249 \\ 1.646 & 1.339 & 1.247 & 1.195 & 1.135 \\ 1.682 & 1.317 & 1.204 & 1.138 & 1.068 \\ 1.694 & 1.299 & 1.172 & 1.097 & 1.021 \end{bmatrix}$$

TABLE 9

Cropped delta wing, aspect ratio 3, taper ratio $^1/_7$

Values of $(\ell_{\dot{\alpha}})$

(i) $\nu_m = 0.2\dot{6}$

$$(\ell_{\dot{\alpha}}) = \begin{bmatrix} 0.6072 & 0.6036 & 0.5348 & 0.5192 & 0.5225 \\ 0.5962 & 0.5188 & 0.5240 & 0.5641 & 0.5994 \\ 0.5433 & 0.4789 & 0.5155 & 0.5734 & 0.6173 \\ 0.4807 & 0.4425 & 0.5041 & 0.5749 & 0.6245 \\ 0.4205 & 0.4056 & 0.4901 & 0.5736 & 0.6284 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$(\ell_{\dot{\alpha}}) = \begin{bmatrix} 0.6478 & 0.6618 & 0.6055 & 0.6002 & 0.6100 \\ 0.6585 & 0.5753 & 0.5794 & 0.6198 & 0.6543 \\ 0.6251 & 0.5389 & 0.5674 & 0.6213 & 0.6620 \\ 0.5791 & 0.5064 & 0.5550 & 0.6194 & 0.6641 \\ 0.5327 & 0.4730 & 0.5409 & 0.6160 & 0.6644 \end{bmatrix}$$

TABLE 10

Cropped delta wing, aspect ratio 3, taper ratio 1/7

Values of $(-m_{\dot{z}})$

(i) $\nu_m = 0.2\dot{6}$

$$(-m_{\dot{z}}) = \begin{bmatrix} -0.3409 & -0.3814 & -0.3731 & -0.3723 & -0.3677 \\ -0.3980 & -0.3556 & -0.3405 & -0.3345 & -0.3239 \\ -0.4366 & -0.3599 & -0.3350 & -0.3223 & -0.3077 \\ -0.4623 & -0.3659 & -0.3334 & -0.3158 & -0.2982 \\ -0.4792 & -0.3698 & -0.3323 & -0.3111 & -0.2911 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$(-m_{\dot{z}}) = \begin{bmatrix} -0.3326 & -0.3706 & -0.3608 & -0.3587 & -0.3535 \\ -0.3873 & -0.3469 & -0.3326 & -0.3268 & -0.3163 \\ -0.4243 & -0.3518 & -0.3284 & -0.3164 & -0.3023 \\ -0.4490 & -0.3579 & -0.3276 & -0.3108 & -0.2938 \\ -0.4650 & -0.3621 & -0.3268 & -0.3067 & -0.2873 \end{bmatrix}$$

TABLE 11

Cropped delta wing, aspect ratio 3, taper ratio $^1/_7$

Values of $(-m_{\dot{\alpha}})$

(i) $\nu_m = 0.2\dot{6}$

$$(-m_{\dot{\alpha}}) = \begin{bmatrix} 0.1443 & 0.2078 & 0.2545 & 0.3082 & 0.3587 \\ 0.1783 & 0.1811 & 0.1980 & 0.2226 & 0.2444 \\ 0.2096 & 0.1805 & 0.1829 & 0.1957 & 0.2072 \\ 0.2399 & 0.1840 & 0.1763 & 0.1826 & 0.1891 \\ 0.2692 & 0.1876 & 0.1723 & 0.1748 & 0.1785 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$(-m_{\dot{\alpha}}) = \begin{bmatrix} 0.1383 & 0.1967 & 0.2380 & 0.2860 & 0.3314 \\ 0.1676 & 0.1694 & 0.1847 & 0.2075 & 0.2277 \\ 0.1941 & 0.1676 & 0.1703 & 0.1829 & 0.1941 \\ 0.2200 & 0.1698 & 0.1640 & 0.1709 & 0.1779 \\ 0.2455 & 0.1723 & 0.1600 & 0.1638 & 0.1634 \end{bmatrix}$$

TABLE 12

Cropped delta wing, aspect ratio 1.2, taper ratio 1/7

Values of (ℓ_z)

(i) $\nu_m = 0.\dot{3}$

$$(\ell_z) = \begin{bmatrix} -0.03550 & -0.02319 & -0.01612 & -0.01277 & -0.01068 \\ -0.02223 & -0.01416 & -0.01118 & -0.009750 & -0.008700 \\ -0.01541 & -0.01032 & -0.008756 & -0.008008 & -0.007365 \\ -0.01146 & -0.008062 & -0.007237 & -0.006856 & -0.006441 \\ -0.008968 & -0.006556 & -0.006178 & -0.006030 & -0.005763 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$(\ell_z) = \begin{bmatrix} -0.1461 & -0.09629 & -0.06754 & -0.05382 & -0.04520 \\ -0.09320 & -0.05940 & -0.04681 & -0.04074 & -0.03627 \\ -0.06585 & -0.04370 & -0.03676 & -0.03340 & -0.03057 \\ -0.04989 & -0.03446 & -0.03046 & -0.02858 & -0.02668 \\ -0.03973 & -0.02827 & -0.02608 & -0.02514 & -0.02385 \end{bmatrix}$$

TABLE 13

Cropped delta wing, aspect ratio 1.2, taper ratio $^{1}/_{7}$

Values of (ℓ_α)

(i) $\nu_m = 0.\dot{3}$

$$(\ell_\alpha) = \begin{bmatrix} 0.8107 & 0.9020 & 0.9246 & 0.9380 & 0.9242 \\ 0.9136 & 0.7818 & 0.7403 & 0.7198 & 0.6906 \\ 0.9667 & 0.7484 & 0.6781 & 0.6412 & 0.6038 \\ 0.9931 & 0.7300 & 0.6440 & 0.5979 & 0.5553 \\ 1.004 & 0.7154 & 0.6206 & 0.5688 & 0.5228 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$(\ell_\alpha) = \begin{bmatrix} 0.8075 & 0.9016 & 0.9251 & 0.9377 & 0.9228 \\ 0.8950 & 0.7744 & 0.7366 & 0.7165 & 0.6870 \\ 0.9403 & 0.7391 & 0.6735 & 0.6374 & 0.5998 \\ 0.9620 & 0.7202 & 0.6394 & 0.5941 & 0.5514 \\ 0.9698 & 0.7054 & 0.6161 & 0.5650 & 0.5189 \end{bmatrix}$$

TABLE 14

Cropped delta wing, aspect ratio 1.2, taper ratio $^1/_7$

Values of $(-m_z)$

(i) $\nu_m = 0.\dot{3}$

$$(-m_z) = \begin{bmatrix} -0.004802 & -0.005200 & -0.005453 & -0.005793 & -0.005984 \\ -0.004144 & -0.003042 & -0.002753 & -0.002732 & -0.002718 \\ -0.003815 & -0.002305 & -0.001906 & -0.001813 & -0.001762 \\ -0.003627 & -0.001923 & -0.001490 & -0.001380 & -0.001321 \\ -0.003503 & -0.001683 & -0.001241 & -0.001127 & -0.001069 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$(-m_z) = \begin{bmatrix} -0.01937 & -0.02091 & -0.02186 & -0.02316 & -0.02388 \\ -0.01590 & -0.01169 & -0.01060 & -0.01054 & -0.01051 \\ -0.01416 & -0.008560 & -0.007125 & -0.006830 & -0.006674 \\ -0.01320 & -0.006975 & -0.005451 & -0.005104 & -0.004931 \\ -0.01262 & -0.006004 & -0.004464 & -0.004118 & -0.003953 \end{bmatrix}$$

TABLE 15

Cropped delta wing, aspect ratio 1.2, taper ratio $^1/_7$

Values of $(-m_\alpha)$

(i) $\nu_m = 0.\dot{3}$

$$(-m_\alpha) = \begin{bmatrix} -0.1620 & -0.1630 & -0.1352 & -0.1119 & -0.09064 \\ -0.2050 & -0.1736 & -0.1576 & -0.1479 & -0.1375 \\ -0.2392 & -0.1886 & -0.1697 & -0.1595 & -0.1495 \\ -0.2657 & -0.2006 & -0.1774 & -0.1650 & -0.1538 \\ -0.2859 & -0.2096 & -0.1826 & -0.1679 & -0.1552 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$(-m_\alpha) = \begin{bmatrix} -0.1731 & -0.1716 & -0.1403 & -0.1154 & -0.09352 \\ -0.2121 & -0.1772 & -0.1595 & -0.1493 & -0.1388 \\ -0.2435 & -0.1902 & -0.1704 & -0.1600 & -0.1502 \\ -0.2681 & -0.2010 & -0.1774 & -0.1651 & -0.1541 \\ -0.2869 & -0.2091 & -0.1820 & -0.1677 & -0.1553 \end{bmatrix}$$

TABLE 16

Cropped delta wing, aspect ratio 1.2, taper ratio $^{1}/_{7}$

Values of (ℓ_z)

(i) $\nu_m = 0.\dot{3}$

$$(\ell_z) = \begin{bmatrix} 0.8055 & 0.8966 & 0.9197 & 0.9334 & 0.9201 \\ 0.9100 & 0.7787 & 0.7377 & 0.7176 & 0.6888 \\ 0.9637 & 0.7460 & 0.6762 & 0.6398 & 0.6027 \\ 0.9905 & 0.7279 & 0.6425 & 0.5968 & 0.5545 \\ 1.0017 & 0.7134 & 0.6191 & 0.5678 & 0.5221 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$(\ell_z) = \begin{bmatrix} 0.7880 & 0.8814 & 0.9064 & 0.9205 & 0.9072 \\ 0.8827 & 0.7635 & 0.7271 & 0.7084 & 0.6802 \\ 0.9309 & 0.7309 & 0.6667 & 0.6321 & 0.5958 \\ 0.9541 & 0.7131 & 0.6338 & 0.5900 & 0.5486 \\ 0.9628 & 0.6988 & 0.6111 & 0.5617 & 0.5168 \end{bmatrix}$$

TABLE 17

Cropped delta wing, aspect ratio 1.2, taper ratio $^1/_7$

Values of (ℓ_α)

(i) $\nu_m = 0.\dot{3}$

$$(\ell_\alpha) = \begin{bmatrix} 0.5175 & 0.5799 & 0.5777 & 0.5940 & 0.6066 \\ 0.6206 & 0.5334 & 0.5187 & 0.5348 & 0.5472 \\ 0.6866 & 0.5314 & 0.5049 & 0.5147 & 0.5224 \\ 0.7317 & 0.5325 & 0.4989 & 0.5047 & 0.5087 \\ 0.7637 & 0.5314 & 0.4941 & 0.4983 & 0.4998 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$(\ell_\alpha) = \begin{bmatrix} 0.5190 & 0.5863 & 0.5885 & 0.6079 & 0.6223 \\ 0.6217 & 0.5400 & 0.5285 & 0.5457 & 0.5584 \\ 0.6877 & 0.5391 & 0.5149 & 0.5250 & 0.5320 \\ 0.7326 & 0.5413 & 0.5093 & 0.5148 & 0.5177 \\ 0.7639 & 0.5410 & 0.5051 & 0.5084 & 0.5083 \end{bmatrix}$$

TABLE 18

Cropped delta wing, aspect ratio 1.2, taper ratio $^1/_7$

Values of $(-m_{\dot{z}})$

(i) $\nu_m = 0.\dot{3}$

$$(-m_{\dot{z}}) = \begin{bmatrix} -0.1576 & -0.1588 & -0.1317 & -0.1087 & -0.08744 \\ -0.2011 & -0.1710 & -0.1555 & -0.1460 & -0.1358 \\ -0.2356 & -0.1865 & -0.1682 & -0.1581 & -0.1483 \\ -0.2622 & -0.1989 & -0.1762 & -0.1639 & -0.1528 \\ -0.2824 & -0.2080 & -0.1815 & -0.1670 & -0.1544 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$(-m_{\dot{z}}) = \begin{bmatrix} -0.1556 & -0.1547 & -0.1262 & -0.1023 & -0.08080 \\ -0.1969 & -0.1670 & -0.1515 & -0.1420 & -0.1319 \\ -0.2296 & -0.1823 & -0.1646 & -0.1549 & -0.1453 \\ -0.2548 & -0.1944 & -0.1728 & -0.1610 & -0.1502 \\ -0.2739 & -0.2033 & -0.1782 & -0.1643 & -0.1521 \end{bmatrix}$$

TABLE 19

Cropped delta wing, aspect ratio 1.2, taper ratio $^1/_7$

Values of $(-m_{\dot{\alpha}})$

(i) $\nu_m = 0.\dot{3}$

$$(-m_{\dot{\alpha}}) = \begin{bmatrix} 0.09106 & 0.1370 & 0.1786 & 0.2291 & 0.2797 \\ 0.09904 & 0.1034 & 0.1202 & 0.1445 & 0.1683 \\ 0.1030 & 0.09157 & 0.1006 & 0.1170 & 0.1329 \\ 0.1058 & 0.08415 & 0.08966 & 0.1030 & 0.1156 \\ 0.1087 & 0.07805 & 0.08193 & 0.09420 & 0.1054 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$(-m_{\dot{\alpha}}) = \begin{bmatrix} 0.09171 & 0.1383 & 0.1803 & 0.2310 & 0.2815 \\ 0.09887 & 0.1031 & 0.1197 & 0.1436 & 0.1670 \\ 0.1018 & 0.09027 & 0.09906 & 0.1153 & 0.1309 \\ 0.1036 & 0.08213 & 0.08757 & 0.1008 & 0.1133 \\ 0.1057 & 0.07547 & 0.07941 & 0.09171 & 0.1030 \end{bmatrix}$$

TABLE 20

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of (ℓ_z)

(i) $\nu_m = 0.303$

$$(\ell_z) = \begin{bmatrix} -0.02406 & -0.01875 & -0.01535 & -0.01348 & -0.01202 \\ -0.01621 & -0.01342 & -0.01227 & -0.01143 & -0.01053 \\ -0.01201 & -0.01096 & -0.01054 & -0.01005 & -0.009386 \\ -0.009483 & -0.009387 & -0.009350 & -0.009059 & -0.008532 \\ -0.007834 & -0.008265 & -0.008464 & -0.008305 & -0.007868 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$(\ell_z) = \begin{bmatrix} -0.1013 & -0.07912 & -0.06469 & -0.05665 & -0.05035 \\ -0.06999 & -0.05706 & -0.05155 & -0.04762 & -0.04363 \\ -0.05295 & -0.04689 & -0.04433 & -0.04183 & -0.03879 \\ -0.04254 & -0.04041 & -0.03940 & -0.03770 & -0.03522 \\ -0.03563 & -0.03577 & -0.03574 & -0.03458 & -0.03247 \end{bmatrix}$$

TABLE 21

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of (ℓ_α)

(i) $\nu_m = 0.303$

$$(\ell_\alpha) = \begin{bmatrix} 0.8271 & 0.7985 & 0.7383 & 0.6935 & 0.6437 \\ 0.8430 & 0.6569 & 0.5794 & 0.5328 & 0.4888 \\ 0.8267 & 0.5981 & 0.5135 & 0.4648 & 0.4220 \\ 0.8005 & 0.5588 & 0.4723 & 0.4230 & 0.3812 \\ 0.7720 & 0.5280 & 0.4422 & 0.3933 & 0.3523 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$(\ell_\alpha) = \begin{bmatrix} 0.8133 & 0.7888 & 0.7320 & 0.6891 & 0.6406 \\ 0.8222 & 0.6457 & 0.5728 & 0.5286 & 0.4861 \\ 0.8031 & 0.5865 & 0.5069 & 0.4607 & 0.4196 \\ 0.7757 & 0.5471 & 0.4659 & 0.4192 & 0.3789 \\ 0.7467 & 0.5164 & 0.4359 & 0.3896 & 0.3501 \end{bmatrix}$$

TABLE 22

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of $(-m_z)$

(i) $\nu_m = 0.303$

$$(-m_z) = \begin{bmatrix} -0.003742 & -0.003389 & -0.003105 & -0.002999 & -0.002889 \\ -0.004045 & -0.001994 & -0.001380 & -0.001260 & -0.001240 \\ -0.003575 & -0.001725 & -0.001211 & -0.001067 & -0.0009967 \\ -0.002869 & -0.001240 & -0.0008435 & -0.0007491 & -0.0007090 \\ -0.003529 & -0.001332 & -0.0008045 & -0.0006738 & -0.0006208 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$(-m_z) = \begin{bmatrix} -0.01377 & -0.01282 & -0.01196 & -0.01163 & -0.01123 \\ -0.01421 & -0.007190 & -0.005162 & -0.004817 & -0.004786 \\ -0.01192 & -0.006082 & -0.004502 & -0.004069 & -0.003844 \\ -0.008849 & -0.004140 & -0.003057 & -0.002827 & -0.002719 \\ -0.01140 & -0.004538 & -0.002935 & -0.002554 & -0.002392 \end{bmatrix}$$

TABLE 23

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of $(-m_\alpha)$

(i) $\nu_m = 0.303$

$$(-m_\alpha) = \begin{bmatrix} -0.1906 & -0.1778 & -0.1527 & -0.1372 & -0.1242 \\ -0.2220 & -0.1755 & -0.1561 & -0.1456 & -0.1355 \\ -0.2452 & -0.1823 & -0.1578 & -0.1433 & -0.1304 \\ -0.2567 & -0.1857 & -0.1587 & -0.1426 & -0.1287 \\ -0.2552 & -0.1800 & -0.1524 & -0.1362 & -0.1225 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$(-m_\alpha) = \begin{bmatrix} -0.1936 & -0.1795 & -0.1531 & -0.1367 & -0.1232 \\ -0.2239 & -0.1761 & -0.1560 & -0.1451 & -0.1348 \\ -0.2450 & -0.1826 & -0.1581 & -0.1434 & -0.1303 \\ -0.2545 & -0.1854 & -0.1588 & -0.1426 & -0.1285 \\ -0.2542 & -0.1801 & -0.1526 & -0.1363 & -0.1224 \end{bmatrix}$$

TABLE 24

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of (ℓ_z)

(i) $\nu_m = 0.303$

$$(\ell_z) = \begin{bmatrix} 0.8239 & 0.7957 & 0.7359 & 0.6913 & 0.6418 \\ 0.8402 & 0.6553 & 0.5783 & 0.5318 & 0.4879 \\ 0.8239 & 0.5968 & 0.5127 & 0.4641 & 0.4215 \\ 0.7977 & 0.5577 & 0.4717 & 0.4226 & 0.3808 \\ 0.7692 & 0.5270 & 0.4417 & 0.3929 & 0.3520 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$(\ell_z) = \begin{bmatrix} 0.8024 & 0.7790 & 0.7233 & 0.6810 & 0.6332 \\ 0.8129 & 0.6403 & 0.5687 & 0.5250 & 0.4827 \\ 0.7939 & 0.5825 & 0.5044 & 0.4587 & 0.4177 \\ 0.7664 & 0.5438 & 0.4641 & 0.4179 & 0.3778 \\ 0.7373 & 0.5135 & 0.4346 & 0.3887 & 0.3494 \end{bmatrix}$$

TABLE 25

Arrowhead wing, aspect ratio 1.32, taper ratio $^7/_{18}$, quarter chord sweep 63.4°

Values of (ℓ_α)

(i) $\nu_m = 0.303$

$$(\ell_\alpha) = \begin{bmatrix} 0.4968 & 0.4884 & 0.4460 & 0.4217 & 0.3974 \\ 0.5196 & 0.4334 & 0.4030 & 0.3875 & 0.3685 \\ 0.5147 & 0.4108 & 0.3810 & 0.3655 & 0.3470 \\ 0.5010 & 0.3930 & 0.3641 & 0.3485 & 0.3299 \\ 0.4849 & 0.3768 & 0.3496 & 0.3344 & 0.3158 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$(\ell_\alpha) = \begin{bmatrix} 0.5021 & 0.4991 & 0.4590 & 0.4345 & 0.4089 \\ 0.5254 & 0.4447 & 0.4150 & 0.3982 & 0.3773 \\ 0.5199 & 0.4230 & 0.3933 & 0.3757 & 0.3548 \\ 0.5048 & 0.4059 & 0.3767 & 0.3585 & 0.3374 \\ 0.4872 & 0.3902 & 0.3623 & 0.3442 & 0.3230 \end{bmatrix}$$

TABLE 26

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of $(-m_{\dot{z}})$

(i) $\nu_m = 0.303$

$$(-m_{\dot{z}}) = \begin{bmatrix} -0.1880 & -0.1757 & -0.1511 & -0.1358 & -0.1229 \\ -0.2193 & -0.1741 & -0.1551 & -0.1447 & -0.1346 \\ -0.2427 & -0.1810 & -0.1569 & -0.1425 & -0.1297 \\ -0.2545 & -0.1846 & -0.1579 & -0.1419 & -0.1280 \\ -0.2527 & -0.1790 & -0.1518 & -0.1356 & -0.1219 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$(-m_{\dot{z}}) = \begin{bmatrix} -0.1834 & -0.1711 & -0.1465 & -0.1310 & -0.1179 \\ -0.2138 & -0.1705 & -0.1520 & -0.1415 & -0.1313 \\ -0.2362 & -0.1778 & -0.1544 & -0.1401 & -0.1272 \\ -0.2473 & -0.1815 & -0.1557 & -0.1397 & -0.1258 \\ -0.2459 & -0.1763 & -0.1498 & -0.1337 & -0.1199 \end{bmatrix}$$

TABLE 27

Arrowhead wing, aspect ratio 1.32, taper ratio $^7/_{18}$, quarter chord sweep 63.4°

Values of $(-m_{\dot\alpha})$

(i) $\nu_m = 0.303$

$$(-m_{\dot\alpha}) = \begin{bmatrix} 0.07849 & 0.05906 & 0.1148 & 0.1262 & 0.1325 \\ 0.05297 & 0.06823 & 0.06671 & 0.07349 & 0.07991 \\ 0.07889 & 0.06307 & 0.06444 & 0.06913 & 0.07205 \\ 0.05453 & 0.04698 & 0.05200 & 0.05780 & 0.06104 \\ 0.08237 & 0.05154 & 0.05050 & 0.05436 & 0.05672 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$(-m_{\dot\alpha}) = \begin{bmatrix} 0.07669 & 0.05873 & 0.1150 & 0.1265 & 0.1324 \\ 0.04980 & 0.06713 & 0.06724 & 0.07419 & 0.08029 \\ 0.07055 & 0.06153 & 0.06484 & 0.06971 & 0.07236 \\ 0.04365 & 0.04523 & 0.05248 & 0.05844 & 0.06140 \\ 0.06930 & 0.04970 & 0.05113 & 0.05515 & 0.05718 \end{bmatrix}$$

TABLE 28

Cropped delta wing, aspect ratio 3, taper ratio $^1/_7$

Values of $[\ell_z]$

(i) $\nu_m = 0.2\dot{6}$

$$[\ell_z] = \begin{bmatrix} -0.016877 & -0.003842 & -0.001096 & -0.000454 & -0.000262 \\ -0.001863 & -0.001043 & -0.000818 & -0.000695 & -0.000591 \\ 0.0007115 & -0.000256 & -0.000512 & -0.000556 & -0.000525 \\ 0.001251 & 0.000045 & -0.000322 & -0.000429 & -0.000438 \\ 0.001295 & 0.000174 & -0.000205 & -0.000336 & -0.000366 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$[\ell_z] = \begin{bmatrix} -0.04775 & -0.01245 & -0.004504 & -0.002331 & -0.001502 \\ -0.008588 & -0.004056 & -0.002755 & -0.002150 & -0.001736 \\ -0.001072 & -0.001616 & -0.001707 & -0.001607 & -0.001428 \\ 0.0009661 & -0.0006178 & -0.001109 & -0.001213 & -0.001157 \\ 0.001537 & -0.0001450 & -0.0007491 & -0.0009408 & -0.0009499 \end{bmatrix}$$

TABLE 29

Cropped delta wing, aspect ratio 3, taper ratio $^1/7$

Values of $[\ell_\alpha]$

(i) $\nu_m = 0.2\dot{6}$

$$[\ell_\alpha] = \begin{bmatrix} 1.501 & 0.6106 & 0.3415 & 0.2264 & 0.1613 \\ 0.6285 & 0.3016 & 0.1895 & 0.1344 & 0.09989 \\ 0.3675 & 0.1929 & 0.1292 & 0.09537 & 0.07291 \\ 0.2483 & 0.1379 & 0.09628 & 0.07309 & 0.05701 \\ 0.1822 & 0.1051 & 0.07562 & 0.05863 & 0.04642 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$[\ell_\alpha] = \begin{bmatrix} 1.473 & 0.5961 & 0.3357 & 0.2226 & 0.1586 \\ 0.6148 & 0.2966 & 0.1869 & 0.1326 & 0.09865 \\ 0.3588 & 0.1899 & 0.1276 & 0.09432 & 0.07215 \\ 0.2422 & 0.1358 & 0.09519 & 0.07237 & 0.05648 \\ 0.1775 & 0.1035 & 0.07482 & 0.05809 & 0.04603 \end{bmatrix}$$

TABLE 30

Cropped delta wing, aspect ratio 3, taper ratio $^1/7$

Values of $[-m_z]$

(i) $\nu_m = 0.2\dot{6}$

$$[-m_z] = \begin{bmatrix} -0.008716 & -0.003201 & -0.001653 & -0.001049 & -0.0007293 \\ -0.003102 & -0.001186 & -0.0006330 & -0.0004093 & -0.0002877 \\ -0.001632 & -0.0006348 & -0.0003451 & -0.0002264 & -0.0001608 \\ -0.001020 & -0.0003994 & -0.0002195 & -0.0001457 & -0.0001046 \\ -0.0007045 & -0.0002759 & -0.0001528 & -0.0001024 & -0.0000742 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$[-m_z] = \begin{bmatrix} -0.01760 & -0.006398 & -0.003279 & -0.002074 & -0.001440 \\ -0.006158 & -0.002347 & -0.001251 & -0.0008092 & -0.0005693 \\ -0.003216 & -0.001252 & -0.0006819 & -0.0004487 & -0.0003197 \\ -0.002006 & -0.0007867 & -0.0004344 & -0.0002897 & -0.0002089 \\ -0.001385 & -0.0005436 & -0.0003027 & -0.0002042 & -0.0001489 \end{bmatrix}$$

TABLE 31

Cropped delta wing, aspect ratio 3, taper ratio $^{1}/_{7}$

Values of $[-m_\alpha]$

(i) $\nu_m = 0.2\dot{6}$

$$[-m_\alpha] = \begin{bmatrix} -0.4108 & -0.1327 & -0.05968 & -0.03404 & -0.02185 \\ -0.1385 & -0.05682 & -0.03108 & -0.01984 & -0.01357 \\ -0.06991 & -0.03287 & -0.01986 & -0.01350 & -0.009662 \\ -0.04235 & -0.02171 & -0.01396 & -0.009911 & -0.007330 \\ -0.02853 & -0.01550 & -0.01043 & -0.007645 & -0.005792 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$[-m_\alpha] = \begin{bmatrix} -0.4080 & -0.1309 & -0.05838 & -0.03313 & -0.02120 \\ -0.1367 & -0.05603 & -0.03061 & -0.01952 & -0.01335 \\ -0.06878 & -0.03241 & -0.01959 & -0.01333 & -0.009543 \\ -0.04159 & -0.02140 & -0.01380 & -0.009804 & -0.007254 \\ -0.02799 & -0.01529 & -0.01031 & -0.007569 & -0.005740 \end{bmatrix}$$

TABLE 32

Cropped delta wing, aspect ratio 3, taper ratio $^1/_7$

Values of $[\ell_z]$

(i) $\nu_m = 0.2\dot{6}$

$$[\ell_z] = \begin{bmatrix} 1.490 & 0.6070 & 0.3399 & 0.2255 & 0.1608 \\ 0.6244 & 0.3001 & 0.1888 & 0.1340 & 0.09964 \\ 0.3651 & 0.1920 & 0.1288 & 0.09511 & 0.07276 \\ 0.2467 & 0.1373 & 0.09596 & 0.07291 & 0.05690 \\ 0.1810 & 0.1046 & 0.07537 & 0.05849 & 0.04634 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$[\ell_z] = \begin{bmatrix} 1.452 & 0.5929 & 0.3325 & 0.2208 & 0.1575 \\ 0.6069 & 0.2937 & 0.1855 & 0.1318 & 0.09815 \\ 0.3543 & 0.1881 & 0.1267 & 0.09381 & 0.07185 \\ 0.2392 & 0.1345 & 0.09456 & 0.07201 & 0.05627 \\ 0.1754 & 0.1026 & 0.07433 & 0.05782 & 0.04586 \end{bmatrix}$$

(iii) $\nu_m = 0.5\dot{3}$

$$[\ell_z] = \begin{bmatrix} 1.413 & 0.5786 & 0.3251 & 0.2160 & 0.1542 \\ 0.5884 & 0.2871 & 0.1821 & 0.1297 & 0.09665 \\ 0.3429 & 0.1841 & 0.1247 & 0.09251 & 0.07093 \\ 0.2312 & 0.1317 & 0.09314 & 0.07110 & 0.05563 \\ 0.1694 & 0.1005 & 0.07328 & 0.05714 & 0.04538 \end{bmatrix}$$

TABLE 33

Cropped delta wing, aspect ratio 3, taper ratio 1/7

Values of $[\ell_{\dot\alpha}]$

(i) $\nu_m = 0.2\dot{6}$

$$[\ell_{\dot\alpha}] = \begin{bmatrix} 0.7211 & 0.2075 & 0.08468 & 0.04705 & 0.03079 \\ 0.2050 & 0.08214 & 0.04749 & 0.03324 & 0.02497 \\ 0.08603 & 0.04340 & 0.03038 & 0.02389 & 0.01929 \\ 0.04357 & 0.02608 & 0.02100 & 0.01797 & 0.01529 \\ 0.02478 & 0.01690 & 0.01532 & 0.01404 & 0.01246 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$[\ell_{\dot\alpha}] = \begin{bmatrix} 0.7693 & 0.2275 & 0.09588 & 0.05439 & 0.03595 \\ 0.2264 & 0.09109 & 0.05251 & 0.03653 & 0.02726 \\ 0.09898 & 0.04884 & 0.03344 & 0.02589 & 0.02069 \\ 0.05248 & 0.02984 & 0.02312 & 0.01936 & 0.01626 \\ 0.03139 & 0.01971 & 0.01690 & 0.01508 & 0.01317 \end{bmatrix}$$

TABLE 34

Cropped delta wing, aspect ratio 3, taper ratio 1/7

Values of $[-m_z]$

(i) $\nu_m = 0.2\dot{6}$

$$[-m_z] = \begin{bmatrix} -0.4048 & -0.1311 & -0.05908 & -0.03374 & -0.02167 \\ -0.1368 & -0.05630 & -0.03086 & -0.01971 & -0.01349 \\ -0.06913 & -0.03262 & -0.01974 & -0.01343 & -0.009616 \\ -0.04190 & -0.02156 & -0.01389 & -0.009868 & -0.007300 \\ -0.02824 & -0.01541 & -0.01038 & -0.007615 & -0.005771 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$[-m_z] = \begin{bmatrix} -0.3950 & -0.1274 & -0.05713 & -0.03251 & -0.02083 \\ -0.1332 & -0.05493 & -0.03014 & -0.01926 & -0.01318 \\ -0.06718 & -0.03188 & -0.01935 & -0.01318 & -0.009447 \\ -0.04069 & -0.02109 & -0.01365 & -0.009713 & -0.007192 \\ -0.02740 & -0.01509 & -0.01021 & -0.007507 & -0.005696 \end{bmatrix}$$

TABLE 35

Cropped delta wing, aspect ratio 3, taper ratio $^1/_7$

Values of $[-m_{\dot{\alpha}}]$

(i) $\nu_m = 0.2\dot{6}$

$$[-m_{\dot{\alpha}}] = \begin{bmatrix} 0.2254 & 0.07564 & 0.03593 & 0.02164 & 0.01457 \\ 0.06493 & 0.02556 & 0.01390 & 0.009044 & 0.006363 \\ 0.02959 & 0.01267 & 0.007429 & 0.005096 & 0.003723 \\ 0.01684 & 0.007476 & 0.004590 & 0.003281 & 0.002478 \\ 0.01094 & 0.004885 & 0.003096 & 0.002290 & 0.001780 \end{bmatrix}$$

(ii) $\nu_m = 0.4$

$$[-m_{\dot{\alpha}}] = \begin{bmatrix} 0.2161 & 0.07162 & 0.03360 & 0.02008 & 0.01346 \\ 0.06103 & 0.02392 & 0.01297 & 0.008430 & 0.005929 \\ 0.02740 & 0.01177 & 0.006920 & 0.004762 & 0.003488 \\ 0.01544 & 0.006900 & 0.004270 & 0.003071 & 0.002331 \\ 0.009972 & 0.004488 & 0.002875 & 0.002146 & 0.001680 \end{bmatrix}$$

TABLE 36

Cropped delta wing, aspect ratio 1.2, taper ratio 1/7

Values of $[\ell_z]$

(i) $\nu_m = 0.\dot{3}$

$$[\ell_z] = \begin{bmatrix} -0.03550 & -0.01159 & -0.005372 & -0.003191 & -0.002137 \\ -0.01112 & -0.004720 & -0.002794 & -0.001950 & -0.001450 \\ -0.005136 & -0.002580 & -0.001751 & -0.001335 & -0.001052 \\ -0.002864 & -0.001613 & -0.001206 & -0.0009794 & -0.0008051 \\ -0.001794 & -0.001093 & -0.0008825 & -0.0007538 & -0.0006403 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$[\ell_z] = \begin{bmatrix} -0.1461 & -0.04814 & -0.02251 & -0.01346 & -0.009041 \\ -0.04660 & -0.01980 & -0.01170 & -0.008149 & -0.006045 \\ -0.02195 & -0.01093 & -0.007352 & -0.005566 & -0.004368 \\ -0.01247 & -0.006893 & -0.005078 & -0.004083 & -0.003335 \\ -0.007947 & -0.004712 & -0.003726 & -0.003143 & -0.002650 \end{bmatrix}$$

TABLE 37

Cropped delta wing, aspect ratio 1.2, taper ratio $^1/_7$

Values of $[\ell_\alpha]$

(i) $\nu_m = 0.\dot{3}$

$$[\ell_\alpha] = \begin{bmatrix} 0.8107 & 0.3383 & 0.1926 & 0.1290 & 0.09242 \\ 0.3426 & 0.1629 & 0.1018 & 0.07198 & 0.05344 \\ 0.2014 & 0.1029 & 0.06781 & 0.04962 & 0.03774 \\ 0.1366 & 0.07300 & 0.04984 & 0.03737 & 0.02892 \\ 0.1004 & 0.05536 & 0.03879 & 0.02962 & 0.02323 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$[\ell_\alpha] = \begin{bmatrix} 0.8075 & 0.3381 & 0.1927 & 0.1289 & 0.09228 \\ 0.3356 & 0.1613 & 0.1013 & 0.07165 & 0.05316 \\ 0.1959 & 0.1016 & 0.06735 & 0.04933 & 0.03749 \\ 0.1323 & 0.07202 & 0.04948 & 0.03713 & 0.02872 \\ 0.09698 & 0.05459 & 0.03850 & 0.02943 & 0.02306 \end{bmatrix}$$

TABLE 38

Cropped delta wing, aspect ratio 1.2, taper ratio 1/7

Values of $[-m_z]$

(i) $\nu_m = 0.\dot{3}$

$$[-m_z] = \begin{bmatrix} -0.004802 & -0.001950 & -0.001136 & -0.0007965 & -0.0005984 \\ -0.001554 & -0.0006338 & -0.0003786 & -0.0002732 & -0.0002103 \\ -0.0007947 & -0.0003170 & -0.0001906 & -0.0001403 & -0.0001101 \\ -0.0004987 & -0.0001923 & -0.0001153 & -0.00008622 & -0.00006878 \\ -0.0003503 & -0.0001302 & -0.00007754 & -0.00005871 & -0.00004751 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$[-m_z] = \begin{bmatrix} -0.01937 & -0.007843 & -0.004554 & -0.003185 & -0.002388 \\ -0.005964 & -0.002435 & -0.001458 & -0.001054 & -0.0008131 \\ -0.002950 & -0.001177 & -0.0007125 & -0.0005285 & -0.0004171 \\ -0.001815 & -0.0006975 & -0.0004218 & -0.0003190 & -0.0002568 \\ -0.001262 & -0.0004646 & -0.0002790 & -0.0002145 & -0.0001757 \end{bmatrix}$$

TABLE 39

Cropped delta wing, aspect ratio 1.2, taper ratio $^1/_7$

Values of $[-m_\alpha]$

(i) $\nu_m = 0.\dot{3}$

$$[-m_\alpha] = \begin{bmatrix} -0.1924 & -0.05602 & -0.02141 & -0.01015 & -0.005341 \\ -0.07046 & -0.02749 & -0.01428 & -0.008715 & -0.005730 \\ -0.03787 & -0.01709 & -0.009998 & -0.006644 & -0.004673 \\ -0.02408 & -0.01182 & -0.007393 & -0.005155 & -0.003765 \\ -0.01685 & -0.008732 & -0.005705 & -0.004109 & -0.003077 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$[-m_\alpha] = \begin{bmatrix} -0.2056 & -0.05897 & -0.02221 & -0.01046 & -0.005511 \\ -0.07292 & -0.02806 & -0.01445 & -0.008797 & -0.005785 \\ -0.03856 & -0.01723 & -0.01004 & -0.006668 & -0.004694 \\ -0.02430 & -0.01185 & -0.007393 & -0.005160 & -0.003773 \\ -0.01691 & -0.008713 & -0.005689 & -0.004104 & -0.003079 \end{bmatrix}$$

TABLE 40

Cropped delta wing, aspect ratio 1.2, taper ratio 1/7

Values of $[\ell_z]$

(i) $\nu_m = 0.\dot{3}$

$$[\ell_z] = \begin{bmatrix} 0.8055 & 0.3362 & 0.1916 & 0.1283 & 0.09201 \\ 0.3413 & 0.1622 & 0.1014 & 0.07176 & 0.05330 \\ 0.2008 & 0.1026 & 0.06762 & 0.04951 & 0.03767 \\ 0.1362 & 0.07279 & 0.04971 & 0.03730 & 0.02888 \\ 0.1002 & 0.05521 & 0.03870 & 0.02957 & 0.02321 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$[\ell_z] = \begin{bmatrix} 0.7880 & 0.3305 & 0.1888 & 0.1266 & 0.09072 \\ 0.3310 & 0.1591 & 0.09997 & 0.07084 & 0.05263 \\ 0.1939 & 0.1005 & 0.06667 & 0.04891 & 0.03724 \\ 0.1312 & 0.07131 & 0.04905 & 0.03688 & 0.02857 \\ 0.09628 & 0.05408 & 0.03819 & 0.02925 & 0.02297 \end{bmatrix}$$

TABLE 41

Cropped delta wing, aspect ratio 1.2, taper ratio $^1/_7$

Values of $[\ell_{\dot\alpha}]$

(i) $\nu_m = 0.\dot{3}$

$$[\ell_{\dot\alpha}] = \begin{bmatrix} 0.6145 & 0.1994 & 0.09146 & 0.05383 & 0.03575 \\ 0.2133 & 0.08445 & 0.04701 & 0.03151 & 0.02280 \\ 0.1087 & 0.04815 & 0.02975 & 0.02145 & 0.01632 \\ 0.06631 & 0.03138 & 0.02079 & 0.01577 & 0.01245 \\ 0.04500 & 0.02214 & 0.01544 & 0.01220 & 0.009907 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$[\ell_{\dot\alpha}] = \begin{bmatrix} 0.6163 & 0.2015 & 0.09319 & 0.05500 & 0.03667 \\ 0.2137 & 0.08550 & 0.04789 & 0.03216 & 0.02327 \\ 0.1089 & 0.04885 & 0.03034 & 0.02187 & 0.01663 \\ 0.06639 & 0.03190 & 0.02122 & 0.01609 & 0.01267 \\ 0.04502 & 0.02254 & 0.01579 & 0.01244 & 0.01008 \end{bmatrix}$$

TABLE 42

Cropped delta wing, aspect ratio 1.2, taper ratio $^1/_7$

Values of $[-m_z]$

(i) $\nu_m = 0.\dot{3}$

$$[-m_z] = \begin{bmatrix} -0.1872 & -0.05458 & -0.02085 & -0.009850 & -0.005153 \\ -0.06912 & -0.02708 & -0.01409 & -0.008606 & -0.005657 \\ -0.03730 & -0.01691 & -0.009910 & -0.006588 & -0.004633 \\ -0.02376 & -0.01172 & -0.007343 & -0.005122 & -0.003740 \\ -0.01664 & -0.008668 & -0.005673 & -0.004087 & -0.003060 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$[-m_z] = \begin{bmatrix} -0.1847 & -0.05319 & -0.01998 & -0.009273 & -0.004761 \\ -0.06768 & -0.02644 & -0.01373 & -0.008370 & -0.005496 \\ -0.03636 & -0.01652 & -0.009697 & -0.006452 & -0.004540 \\ -0.02309 & -0.01146 & -0.007201 & -0.005032 & -0.003678 \\ -0.01614 & -0.008472 & -0.005569 & -0.004021 & -0.003015 \end{bmatrix}$$

TABLE 43

Cropped delta wing, aspect ratio 1.2, taper ratio $^1/_7$

Values of $[-m_{\dot{\alpha}}]$

(i) $\nu_m = 0.\dot{3}$

$$[-m_{\dot{\alpha}}] = \begin{bmatrix} 0.1423 & 0.04989 & 0.02521 & 0.01608 & 0.01136 \\ 0.03606 & 0.01459 & 0.008439 & 0.005871 & 0.004382 \\ 0.01453 & 0.006428 & 0.004086 & 0.003047 & 0.002387 \\ 0.007428 & 0.003419 & 0.002335 & 0.001851 & 0.001515 \\ 0.004416 & 0.002033 & 0.001472 & 0.001234 & 0.001051 \end{bmatrix}$$

(ii) $\nu_m = 0.\dot{6}$

$$[-m_{\dot{\alpha}}] = \begin{bmatrix} 0.1433 & 0.05035 & 0.02546 & 0.01622 & 0.01143 \\ 0.03600 & 0.01455 & 0.008400 & 0.005834 & 0.004350 \\ 0.01437 & 0.006337 & 0.004024 & 0.003002 & 0.002352 \\ 0.007276 & 0.003337 & 0.002280 & 0.001811 & 0.001485 \\ 0.004296 & 0.001965 & 0.001427 & 0.001202 & 0.001027 \end{bmatrix}$$

TABLE 44

Arrowhead wing, aspect ratio 1.32, taper ratio $^7/_8$
quarter chord sweep 63.4°

Values of $[\ell_z]$

(i) $\nu_m = 0.303$

$$[\ell_z] = \begin{bmatrix} -0.02406 & -0.009376 & -0.005116 & -0.003370 & -0.002404 \\ -0.008105 & -0.004474 & -0.003067 & -0.002285 & -0.001755 \\ -0.004003 & -0.002739 & -0.002108 & -0.001675 & -0.001341 \\ -0.002371 & -0.001877 & -0.001558 & -0.001294 & -0.001067 \\ -0.001567 & -0.001378 & -0.001209 & -0.001038 & -0.0008742 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$[\ell_z] = \begin{bmatrix} -0.1013 & -0.03956 & -0.02156 & -0.01416 & -0.01007 \\ -0.03500 & -0.01902 & -0.01289 & -0.009525 & -0.007271 \\ -0.01765 & -0.01172 & -0.008866 & -0.006971 & -0.005541 \\ -0.01063 & -0.008082 & -0.006567 & -0.005386 & -0.004403 \\ -0.007126 & -0.005961 & -0.005105 & -0.004322 & -0.003608 \end{bmatrix}$$

TABLE 45

Arrowhead wing, aspect ratio 1.32, taper ratio $^7/_{18}$, quarter chord sweep 63.4°

Values of $[\ell_\alpha]$

(i) $\nu_m = 0.303$

$$[\ell_\alpha] = \begin{bmatrix} 0.8271 & 0.3407 & 0.1920 & 0.1276 & 0.09098 \\ 0.3597 & 0.1708 & 0.1066 & 0.07531 & 0.05586 \\ 0.2149 & 0.1100 & 0.07257 & 0.05312 & 0.04039 \\ 0.1473 & 0.07897 & 0.05398 & 0.04049 & 0.03134 \\ 0.1091 & 0.06034 & 0.04232 & 0.03234 & 0.02536 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$[\ell_\alpha] = \begin{bmatrix} 0.8133 & 0.3366 & 0.1903 & 0.1268 & 0.09054 \\ 0.3508 & 0.1679 & 0.1054 & 0.07471 & 0.05555 \\ 0.2088 & 0.1079 & 0.07164 & 0.05266 & 0.04016 \\ 0.1427 & 0.07733 & 0.05324 & 0.04012 & 0.03116 \\ 0.1055 & 0.05902 & 0.04172 & 0.03203 & 0.02521 \end{bmatrix}$$

TABLE 46

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of $[-m_z]$

(i) $\nu_m = 0.303$

$$[-m_z] = \begin{bmatrix} -0.003742 & -0.001446 & -0.0008073 & -0.0005518 & -0.0004083 \\ -0.001726 & -0.0005183 & -0.0002540 & -0.0001781 & -0.0001417 \\ -0.0009295 & -0.0003173 & -0.0001711 & -0.0001219 & -0.0000954 \\ -0.0005279 & -0.0001753 & -0.0000964 & -0.0000717 & -0.0000583 \\ -0.0004988 & -0.0001522 & -0.0000770 & -0.0000554 & -0.0000447 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$[-m_z] = \begin{bmatrix} -0.01377 & -0.005468 & -0.003109 & -0.002141 & -0.001587 \\ -0.006062 & -0.001869 & -0.0009498 & -0.0006809 & -0.0005470 \\ -0.003100 & -0.001119 & -0.0006362 & -0.0004650 & -0.0003679 \\ -0.001628 & -0.0005852 & -0.0003494 & -0.0002706 & -0.0002235 \\ -0.001611 & -0.0005186 & -0.0002810 & -0.0002100 & -0.0001723 \end{bmatrix}$$

TABLE 47

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of $[-m_\alpha]$

(i) $\nu_m = 0.303$

$$[-m_\alpha] = \begin{bmatrix} -0.2029 & -0.06857 & -0.03245 & -0.01929 & -0.01279 \\ -0.08560 & -0.03729 & -0.02195 & -0.01499 & -0.01088 \\ -0.05210 & -0.02562 & -0.01624 & -0.01152 & -0.008540 \\ -0.03608 & -0.01911 & -0.01275 & -0.009334 & -0.007082 \\ -0.02627 & -0.01447 & -0.009981 & -0.007499 & -0.005801 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$[-m_\alpha] = \begin{bmatrix} -0.2061 & -0.06923 & -0.03253 & -0.01922 & -0.01268 \\ -0.08634 & -0.03742 & -0.02193 & -0.01494 & -0.01083 \\ -0.05205 & -0.02568 & -0.01627 & -0.01152 & -0.008529 \\ -0.03578 & -0.01909 & -0.01276 & -0.009335 & -0.007074 \\ -0.02617 & -0.01447 & -0.009992 & -0.007501 & -0.005796 \end{bmatrix}$$

TABLE 48

Arrowhead wing, aspect ratio 1.32, taper ratio $^7/_{18}$, quarter chord sweep 63.4°

Values of $[\ell_z]$

(i) $\nu_m = 0.303$

$$[\ell_z] = \begin{bmatrix} 0.8239 & 0.3395 & 0.1913 & 0.1272 & 0.09070 \\ 0.3585 & 0.1704 & 0.1064 & 0.07517 & 0.05576 \\ 0.2142 & 0.1098 & 0.07246 & 0.05305 & 0.04034 \\ 0.1468 & 0.07882 & 0.05391 & 0.04045 & 0.03131 \\ 0.1087 & 0.06023 & 0.04228 & 0.03231 & 0.02535 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$[\ell_z] = \begin{bmatrix} 0.8024 & 0.3324 & 0.1880 & 0.1253 & 0.08949 \\ 0.3468 & 0.1665 & 0.1046 & 0.07420 & 0.05517 \\ 0.2064 & 0.1072 & 0.07129 & 0.05242 & 0.03998 \\ 0.1410 & 0.07686 & 0.05305 & 0.04000 & 0.03106 \\ 0.1042 & 0.05869 & 0.04160 & 0.03196 & 0.02516 \end{bmatrix}$$

TABLE 49

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of $[\ell_{\dot{\alpha}}]$

(i) $\nu_m = 0.303$

$$[\ell_{\dot{\alpha}}] = \begin{bmatrix} 0.5288 & 0.1883 & 0.09477 & 0.05929 & 0.04092 \\ 0.2803 & 0.09208 & 0.05665 & 0.03989 & 0.02961 \\ 0.1094 & 0.05776 & 0.03923 & 0.02936 & 0.02272 \\ 0.07043 & 0.04046 & 0.02926 & 0.02282 & 0.01816 \\ 0.04992 & 0.03027 & 0.02289 & 0.01840 & 0.01496 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$[\ell_{\dot{\alpha}}] = \begin{bmatrix} 0.5345 & 0.1924 & 0.09752 & 0.06109 & 0.04210 \\ 0.2026 & 0.09448 & 0.05834 & 0.04099 & 0.03031 \\ 0.1105 & 0.05947 & 0.04049 & 0.03018 & 0.02323 \\ 0.07097 & 0.04179 & 0.03026 & 0.02347 & 0.01857 \\ 0.05016 & 0.03135 & 0.02372 & 0.01895 & 0.01530 \end{bmatrix}$$

TABLE 50

Arrowhead wing, aspect ratio 1.32, taper ratio $^7/_{18}$, quarter chord sweep 63.4°

Values of $[-m_z]$

(i) $\nu_m = 0.303$

$$[-m_z] = \begin{bmatrix} -0.2001 & -0.06774 & -0.03210 & -0.01909 & -0.01265 \\ -0.08455 & -0.03699 & -0.02181 & -0.01490 & -0.01081 \\ -0.05158 & -0.02545 & -0.01615 & -0.01145 & -0.008490 \\ -0.03578 & -0.01901 & -0.01269 & -0.009289 & -0.007045 \\ -0.02602 & -0.01438 & -0.009937 & -0.007465 & -0.005773 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$[-m_z] = \begin{bmatrix} -0.1953 & -0.06597 & -0.03113 & -0.01841 & -0.01214 \\ -0.08244 & -0.03623 & -0.02137 & -0.01457 & -0.01055 \\ -0.05020 & -0.02500 & -0.01590 & -0.01125 & -0.008326 \\ -0.03476 & -0.01869 & -0.01251 & -0.009149 & -0.006924 \\ -0.02531 & -0.01416 & -0.009810 & -0.007360 & -0.005681 \end{bmatrix}$$

TABLE 51

Arrowhead wing, aspect ratio 1.32, taper ratio $^7/_{18}$, quarter chord sweep 63.4°

Values of $[-m_{\dot{\alpha}}]$

(i) $\nu_m = 0.303$

$$[-m_{\dot{\alpha}}] = \begin{bmatrix} 0.09368 & 0.03729 & 0.02092 & 0.01412 & 0.01027 \\ 0.03344 & 0.01244 & 0.007462 & 0.005699 & 0.004641 \\ 0.01438 & 0.007054 & 0.004997 & 0.004015 & 0.003303 \\ 0.006099 & 0.003643 & 0.003020 & 0.002650 & 0.002294 \\ 0.006387 & 0.002993 & 0.002315 & 0.002043 & 0.001797 \end{bmatrix}$$

(ii) $\nu_m = 0.606$

$$[-m_{\dot{\alpha}}] = \begin{bmatrix} 0.09154 & 0.03708 & 0.02096 & 0.01415 & 0.01027 \\ 0.03144 & 0.01224 & 0.007521 & 0.005753 & 0.004663 \\ 0.01286 & 0.006882 & 0.005028 & 0.004049 & 0.003317 \\ 0.004883 & 0.003507 & 0.003048 & 0.002679 & 0.002308 \\ 0.005374 & 0.002887 & 0.002344 & 0.002072 & 0.001812 \end{bmatrix}$$

TABLE 52

Values of $\dfrac{[\ell_z]_{rs}}{\left(\frac{1}{A}\,[\ell_z]_{rs}\right)_{A=0}}$ for cropped delta wings

(i) $A = 3, \quad \nu_m = 0.2\dot{6}$

$$\begin{bmatrix} 1.8970 & 1.8210 & 1.7308 & 1.6912 & 1.6375 \\ 1.8731 & 1.8856 & 1.8880 & 1.8937 & 1.8600 \\ 1.8592 & 1.9203 & 1.9672 & 1.9973 & 1.9763 \\ 1.8503 & 1.9403 & 2.0151 & 2.0614 & 2.0484 \\ 1.8441 & 1.9524 & 2.0472 & 2.1055 & 2.0978 \end{bmatrix}$$

(ii) $A = 1.2, \quad \nu_m = 0.\dot{3}$

$$\begin{bmatrix} 1.0255 & 1.0087 & 0.9758 & 0.9626 & 0.9372 \\ 1.0238 & 1.0194 & 1.0144 & 1.0145 & 0.9949 \\ 1.0225 & 1.0257 & 1.0331 & 1.0396 & 1.0231 \\ 1.0214 & 1.0290 & 1.0440 & 1.0545 & 1.0397 \\ 1.0204 & 1.0305 & 1.0511 & 1.0646 & 1.0506 \end{bmatrix}$$

TABLE 53

Values of $\dfrac{[\ell_{\dot\alpha}]_{rs}}{\left(\frac{1}{A}[\ell_{\dot\alpha}]_{rs}\right)_{A=0}}$ for cropped delta wings

(i) $A = 3, \quad \nu_m = 0.2\dot{6}$

$$\begin{bmatrix} 0.7026 & 0.5882 & 0.4710 & 0.4289 & 0.4142 \\ 0.5384 & 0.5411 & 0.5623 & 0.6093 & 0.6490 \\ 0.4200 & 0.4909 & 0.5850 & 0.6848 & 0.7616 \\ 0.3344 & 0.4418 & 0.5839 & 0.7229 & 0.8291 \\ 0.2714 & 0.3958 & 0.5732 & 0.7449 & 0.8756 \end{bmatrix}$$

(ii) $A = 1.2, \quad \nu_m = 0.\dot{3}$

$$\begin{bmatrix} 0.5987 & 0.5652 & 0.5087 & 0.4907 & 0.4809 \\ 0.5604 & 0.5563 & 0.5567 & 0.5776 & 0.5925 \\ 0.5308 & 0.5447 & 0.5728 & 0.6147 & 0.6444 \\ 0.5090 & 0.5317 & 0.5778 & 0.6347 & 0.6753 \\ 0.4929 & 0.5186 & 0.5779 & 0.6471 & 0.6964 \end{bmatrix}$$

TABLE 54

Values of $\dfrac{[-m_{\dot{z}}]_{rs}}{\left(\frac{1}{A}\,[-m_{\dot{z}}]_{rs}\right)_{A=0}}$ for cropped delta wings

(i) $A = 3, \quad \nu_m = 0.2\dot{6}$

$$\begin{bmatrix} 2.6661 & 3.6390 & 5.2816 & 11.0550 & -154.8 \\ 2.1399 & 2.4198 & 2.6632 & 2.9586 & 3.2329 \\ 1.9104 & 2.0975 & 2.2348 & 2.3589 & 2.4283 \\ 1.7731 & 1.9378 & 2.0494 & 2.1345 & 2.1649 \\ 1.6794 & 1.8357 & 1.9409 & 2.0135 & 2.0306 \end{bmatrix}$$

(ii) $A = 1.2, \quad \nu_m = 0.\dot{3}$

$$\begin{bmatrix} 1.2327 & 1.5148 & 1.8640 & 3.2274 & -36.81 \\ 1.0812 & 1.1639 & 1.2163 & 1.2918 & 1.3553 \\ 1.0307 & 1.0870 & 1.1219 & 1.1572 & 1.1699 \\ 1.0056 & 1.0535 & 1.0832 & 1.1079 & 1.1091 \\ 0.9898 & 1.0328 & 1.0605 & 1.0806 & 1.0767 \end{bmatrix}$$

TABLE 55

Values of $\dfrac{[-m_{\dot{\alpha}}]_{rs}}{\left(\frac{1}{A}\,[-m_{\dot{\alpha}}]_{rs}\right)_{A=0}}$ for cropped delta wings

(i) $A = 3, \quad \nu_m = 0.2\dot{6}$

$$\begin{bmatrix} 0.8897 & 0.8093 & 0.7259 & 0.6996 & 0.6840 \\ 1.0343 & 0.9327 & 0.8786 & 0.8684 & 0.8568 \\ 1.2080 & 1.0443 & 0.9906 & 0.9871 & 0.9785 \\ 1.4256 & 1.1486 & 1.0781 & 1.0787 & 1.0766 \\ 1.6946 & 1.2495 & 1.1494 & 1.1538 & 1.1595 \end{bmatrix}$$

(ii) $A = 1.2, \quad \nu_m = 0.\dot{3}$

$$\begin{bmatrix} 0.5616 & 0.5338 & 0.5094 & 0.5201 & 0.5333 \\ 0.5744 & 0.5326 & 0.5335 & 0.5637 & 0.5900 \\ 0.5934 & 0.5297 & 0.5448 & 0.5902 & 0.6275 \\ 0.6288 & 0.5253 & 0.5484 & 0.6085 & 0.6583 \\ 0.6841 & 0.5199 & 0.5466 & 0.6219 & 0.6847 \end{bmatrix}$$

TABLE 56

Values of $\dfrac{[-m_\alpha]_{rs}}{\left(\frac{1}{A}\,[-m_\alpha]_{rs}\right)_{A=0}}$ for cropped delta wings

(i) $A = 3, \quad \nu_m = 0.2\dot{6}$

$$\begin{bmatrix} 2.6277 & 3.5705 & 5.1243 & 10.3695 & -3034.9 \\ 2.1284 & 2.4056 & 2.6459 & 2.9387 & 3.2109 \\ 1.9076 & 2.0922 & 2.2281 & 2.3520 & 2.4219 \\ 1.7746 & 1.9360 & 2.0460 & 2.1310 & 2.1620 \\ 1.6833 & 1.8356 & 1.9391 & 2.0116 & 2.0289 \end{bmatrix}$$

(ii) $A = 3, \quad \nu_m = 0.4$

$$\begin{bmatrix} 2.5180 & 3.3888 & 4.7773 & 9.2781 & 133.53 \\ 2.0556 & 2.3280 & 2.5616 & 2.8461 & 3.1078 \\ 1.8478 & 2.0363 & 2.1744 & 2.2993 & 2.3703 \\ 1.7223 & 1.8896 & 2.0047 & 2.0923 & 2.1252 \\ 1.6352 & 1.7954 & 1.9042 & 1.9797 & 1.9997 \end{bmatrix}$$

(iii) $A = 1.2, \quad \nu_m = 0.\dot{3}$

$$\begin{bmatrix} 1.2105 & 1.4811 & 1.7982 & 2.9730 & 79.126 \\ 1.0720 & 1.1541 & 1.2060 & 1.2819 & 1.3458 \\ 1.0262 & 1.0814 & 1.1162 & 1.1525 & 1.1665 \\ 1.0037 & 1.0498 & 1.0792 & 1.1047 & 1.1071 \\ 0.9898 & 1.0301 & 1.0574 & 1.0783 & 1.0752 \end{bmatrix}$$

(iv) $A = 1.2, \quad \nu_m = 0.\dot{6}$

$$\begin{bmatrix} 1.1415 & 1.3650 & 1.5794 & 2.3270 & 7.9858 \\ 1.0256 & 1.1011 & 1.1477 & 1.2203 & 1.2831 \\ 0.9872 & 1.0408 & 1.0763 & 1.1151 & 1.1327 \\ 0.9691 & 1.0148 & 1.0463 & 1.0756 & 1.0826 \\ 0.9582 & 0.9983 & 1.0282 & 1.0531 & 1.0540 \end{bmatrix}$$

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Royal Aircraft Estab. Report No. Structures 201 — 533.6.013.422:
1956.4 — 533.691.13
Woodcock, D.L.

AERODYNAMIC DERIVATIVES FOR TWO CROPPED DELTA WINGS AND ONE ARROWHEAD WING OSCILLATING IN DISTORTION MODES

Aerodynamic derivatives are given for three particular planforms oscillating with symmetric distortion modes in incompressible flow. The planforms are:

(i) a cropped delta wing of aspect ratio 3 and taper ratio $^1/7$;
(ii) a cropped delta wing of aspect ratio 1.2 and taper ratio $^1/7$;
(iii) an arrowhead wing of aspect ratio 1.32, taper ratio $^7/18$ and angle of sweep of 63.4^o at the quarter chord.

The results are for modes of the form $|\eta|^n$ for $n = 0(1)4$ where η is a non-dimensional spanwise co-ordinate. They have been determined from

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